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CHRYSLER FULL-SIZE TRUCKS 1989-96 REPAIR MANUAL

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by Jaffer A. Ahmad

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SAFETY NOTICE

Proper service and repair procedures are vital to the safe, reliable operation of all motor vehicles, as well as the personal safety of those performing repairs. This manual outlines procedures for servicing and repairing vehicles using safe, effective methods. The procedures contain many NOTES, CAUTIONS and WARNINGS which should be followed, along with standard procedures to eliminate the possibility of personal injury or improper service which could damage the vehicle or compromise its safety.

It is important to note that repair procedures and techniques, tools and parts for servicing motor vehicles, as well as the skill and experience of the individual performing the work vary widely. It is not possible to anticipate all of the conceivable ways or conditions under which vehicles may be serviced, or to provide cautions as to all possible hazards that may result. Standard and accepted safety precautions and equipment should be used when handling toxic or flammable fluids, and safety goggles or other protection should be used during cutting, grinding, chiseling, prying, or any other process that can cause material removal or projectiles.

Some procedures require the use of tools specially designed for a specific purpose. Before substituting another tool or procedure, you must be completely satisfied that neither your personal safety, nor the performance of the vehicle will be endangered.

Although information in this manual is based on industry sources and is complete as possible at the time of publication, the possibility exists that some car manufacturers made later changes which could not be included here. While striving for total accuracy, the authors or publishers cannot assume responsibility for any errors, changes or omissions that may occur in the compilation of this data.

PART NUMBERS

Part numbers listed in this reference are not recommendations by Haynes North America, Inc. for any product brand name. They are references that can be used with interchange manuals and aftermarket supplier catalogs to locate each brand supplier's discrete part number.

SPECIAL TOOLS

Special tools are recommended by the vehicle manufacturer to perform their specific job. Use has been kept to a minimum, but where absolutely necessary, they are referred to in the text by the part number of the tool manufacturer. These tools can be purchased, under the appropriate part number, from your local dealer or regional distributor, or an equivalent tool can be purchased locally from a tool supplier or parts outlet. Before substituting any tool for the one recommended, read the SAFETY NOTICE at the top of this page.

ACKNOWLEDGMENTS

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HOW TO USE THIS BOOK

This Chilton's Total Car Care manual is intended to help you learn more about the inner workings of your Chrysler full-size truck while saving you money on its upkeep and operation.

The beginning of the book will likely be referred to the most, since that is where you will find information for maintenance and tune-up. The other sections deal with the more complex systems of your vehicle. Systems (from engine through brakes) are covered to the extent that the average do-it-yourselfer can attempt. This book will not explain such things as rebuilding a differential because the expertise required and the special tools necessary make this uneconomical. It will, however, give you detailed instructions to help you change your own brake pads and shoes, replace spark plugs, and perform many more jobs that can save you money and help avoid expensive problems.

A secondary purpose of this book is a reference for owners who want to understand their vehicle and/or their mechanics better.

Where to Begin

Before removing any bolts, read through the entire procedure. This will give you the overall view of what tools and supplies will be required. So read ahead and plan ahead. Each operation should be approached logically and all procedures thoroughly understood before attempting any work.

If repair of a component is not considered practical, we tell you how to remove the part and then how to install the new or rebuilt replacement. In this way, you at least save labor costs.

Avoiding Trouble

Many procedures in this book require you to “label and disconnect . . . “ a group of lines, hoses or wires. Don't be think you can remember where everything goes—you won't. If you hook up vacuum or fuel lines incorrectly, the vehicle may run poorly, if at all. If you hook up electrical wiring incorrectly, you may instantly learn a very expensive lesson.

You don't need to know the proper name for each hose or line. A piece of masking tape on the hose and a piece on its fitting will allow you to assign your own label. As long as you remember your own code, the lines can be reconnected by matching your tags. Remember that tape will dissolve in gasoline or solvents; if a part is to be washed or cleaned, use another method of identification. A permanent felt-tipped marker or a metal scribe can be very handy for marking metal parts. Remove any tape or paper labels after assembly.

Maintenance or Repair?

Maintenance includes routine inspections, adjustments, and replacement of parts which show signs of normal wear. Maintenance compensates for wear or deterioration. Repair implies that something has broken or is not working. A need for a repair is often caused by lack of maintenance. for example: draining and refilling automatic transmission fluid is maintenance recommended at specific intervals. Failure to do this can shorten the life of the transmission/transaxle, requiring very expensive repairs. While no maintenance program can prevent items from eventually breaking or wearing out, a general rule is true: MAINTENANCE IS CHEAPER THAN REPAIR.

Two basic mechanic's rules should be mentioned here. First, whenever the left side of the vehicle or engine is referred to, it means the driver's side. Conversely, the right side of the vehicle means the passenger's side. Second, screws and bolts are removed by turning counterclockwise, and tightened by turning clockwise unless specifically noted.

Safety is always the most important rule. Constantly be aware of the dangers involved in working on an automobile and take the proper precautions. Please refer to the information in this section regarding SERVICING YOUR VEHICLE SAFELY and the SAFETY NOTICE on the acknowledgment page.

Avoiding the Most Common Mistakes

Pay attention to the instructions provided. There are 3 common mistakes in mechanical work:

1. Incorrect order of assembly, disassembly or adjustment. When taking something apart or putting it together, performing steps in the wrong order usually just costs you extra time; however, it CAN break something. Read the entire procedure before beginning. Perform everything in the order in which the instructions say you should, even if you can't see a reason for it. When you're taking apart something that is very intricate, you might want to draw a picture of how it looks when assembled in order to make sure you get everything back in its proper position. When making adjustments, perform them in the proper order. One adjustment possibly will affect another.
2. Overtorquing (or undertorquing). While it is more common for overtorquing to cause damage, undertorquing may allow a fastener to vibrate loose causing serious damage. Especially when dealing with aluminum parts, pay attention to torque specifications and utilize a torque wrench in assembly. If a torque figure is not available, remember that if you are using the right tool to perform the job, you will probably not have to strain yourself to get a fastener tight enough. The pitch of most threads is so slight that the tension you put on the wrench will be multiplied many times in actual force on what you are tightening.

   There are many commercial products available for ensuring that fasteners won't come loose, even if they are not torqued just right (a very common brand is Loctite®). If you're worried about getting something together tight enough to hold, but loose enough to avoid mechanical damage during assembly, one of these products might offer substantial insurance. Before choosing a threadlocking compound, read the label on the package and make sure the product is compatible with the materials, fluids, etc. involved.
3. Crossthreading. This occurs when a part such as a bolt is screwed into a nut or casting at the wrong angle and forced. Crossthreading is more likely to occur if access is difficult. It helps to clean and lubricate fasteners, then to start threading the bolt, spark plug, etc. with your fingers. If you encounter resistance, unscrew the part and start over again at a different angle until it can be inserted and turned several times without much effort. Keep in mind that many parts have tapered threads, so that gentle turning will automatically bring the part you're threading to the proper angle. Don't put a wrench on the part until it's been tightened a couple of turns by hand. If you suddenly encounter resistance, and the part has not seated fully, don't force it. Pull it back out to make sure it's clean and threading properly.

Be sure to take your time and be patient, and always plan ahead. Allow yourself ample time to perform repairs and maintenance.

TOOLS AND EQUIPMENT

➧ See Figures 1 thru 15

Without the proper tools and equipment it is impossible to properly service your vehicle. It would be virtually impossible to catalog every tool that you would need to perform all of the operations in this book. It would be unwise for the amateur to rush out and buy an expensive set of tools on the theory that he/she may need one or more of them at some time.

The best approach is to proceed slowly, gathering a good quality set of those tools that are used most frequently. Don't be misled by the low cost of bargain tools. It is far better to spend a little more for better quality. Forged wrenches, 6 or 12-point sockets and fine tooth ratchets are by far preferable to their less expensive counterparts. As any good mechanic can tell you, there are few worse experiences than trying to work on a vehicle with bad tools. Your monetary savings will be far outweighed by frustration and mangled knuckles.

Begin accumulating those tools that are used most frequently: those associated with routine maintenance and tune-up. In addition to the normal assortment of screwdrivers and pliers, you should have the following tools:

- Wrenches/sockets and combination open end/box end wrenches in sizes ⅛–¾ in. and/or 3mm–19mm 13/16 in. or ⅝ in. spark plug socket (depending on plug type).

➡If possible, buy various length socket drive extensions. Universal-joint and wobble extensions can be extremely useful, but be careful when using them, as they can change the amount of torque applied to the socket.

- Jackstands for support.
- Oil filter wrench.
- Spout or funnel for pouring fluids.

- Grease gun for chassis lubrication (unless your vehicle is not equipped with any grease fittings)
- Hydrometer for checking the battery (unless equipped with a sealed, maintenance-free battery).
- A container for draining oil and other fluids.
- Rags for wiping up the inevitable mess.

In addition to the above items there are several others that are not absolutely necessary, but handy to have around. These include an equivalent oil absorbent gravel, like cat litter, and the usual supply of lubricants, antifreeze and fluids. This is a basic list for routine maintenance, but only your personal needs and desire can accurately determine your list of tools.

After performing a few projects on the vehicle, you'll be amazed at the other tools and non-tools on your workbench. Some useful household items are: a large turkey baster or siphon, empty coffee cans and ice trays (to store parts), a ball of twine, electrical tape for wiring, small rolls of colored tape for tagging lines or hoses, markers and pens, a note pad, golf tees (for plugging vacuum lines), metal coat hangers or a roll of mechanic's wire (to hold things out of the way), dental pick or similar long, pointed probe, a strong magnet, and a small mirror (to see into recesses and under manifolds).

A more advanced set of tools, suitable for tune-up work, can be drawn up easily. While the tools are slightly more sophisticated, they need not be outrageously expensive. There are several inexpensive tach/dwell meters on the market that are every bit as good for the average mechanic as a professional model. Just be sure that it goes to a least 1200–1500 rpm on the tach scale and that it works on 4, 6 and 8-cylinder engines. The key to these purchases is to make them with an eye towards adaptability and wide range. A basic list of tune-up tools could include:

- Tach/dwell meter.
- Spark plug wrench and gapping tool.
- Feeler gauges for valve adjustment.
- Timing light.

The choice of a timing light should be made carefully. A light which works on the DC current supplied by the vehicle's battery is the best choice; it should have a xenon tube for brightness. On any vehicle with an electronic ignition sys-

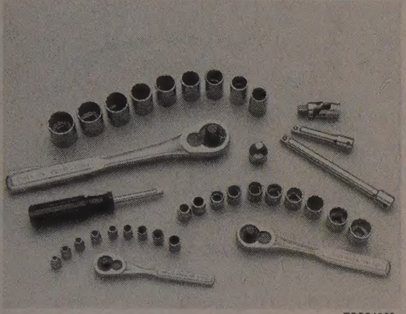
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Fig. 1 All but the most basic procedures will require an assortment of ratchets and sockets

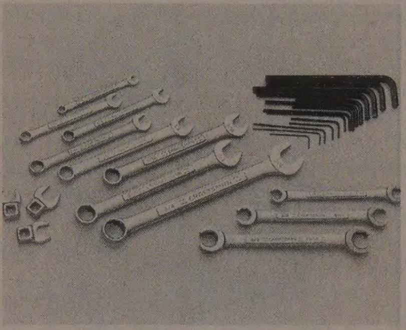
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Fig. 2 In addition to ratchets, a good set of wrenches and hex keys will be necessary

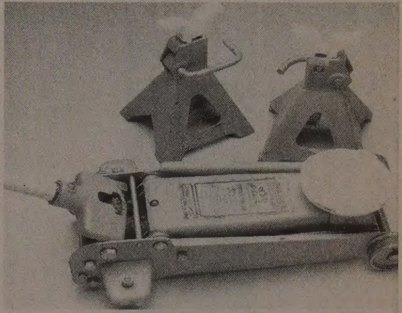
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Fig. 3 A hydraulic floor jack and a set of jackstands are essential for lifting and supporting the vehicle

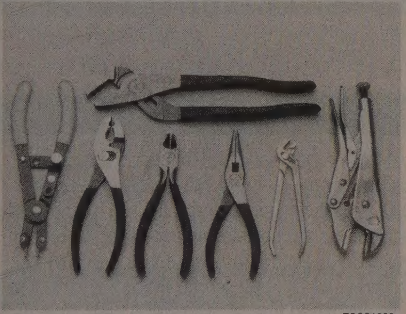
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Fig. 4 An assortment of pliers, grippers and cutters will be handy for old rusted parts and stripped bolt heads

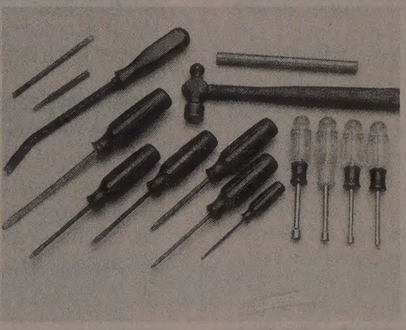
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Fig. 5 Various drivers, chisels and prybars are great tools to have in your toolbox

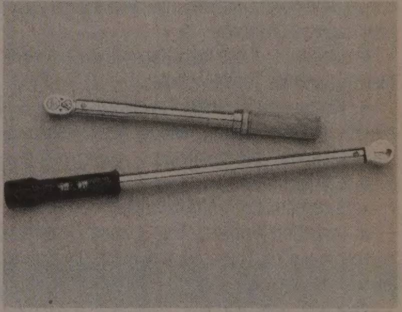
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Fig. 6 Many repairs will require the use of a torque wrench to assure the components are properly fastened

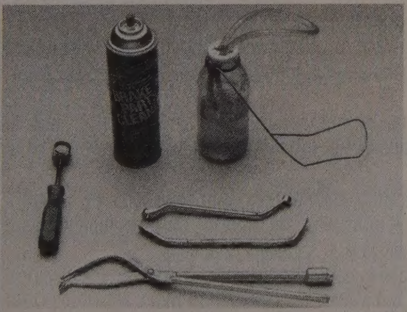

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Fig. 7 Although not always necessary, using specialized brake tools will save time

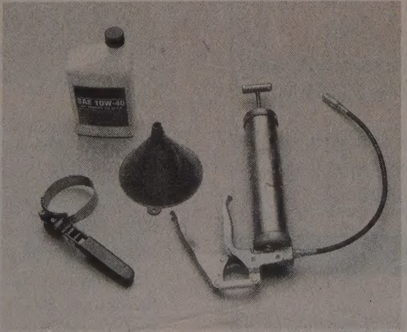

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Fig. 8 A few inexpensive lubrication tools will make maintenance easier

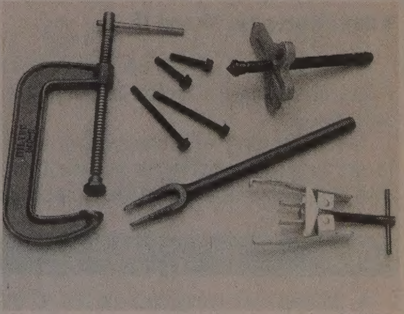
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Fig. 9 Various pullers, clamps and separator tools are needed for many larger, more complicated repairs

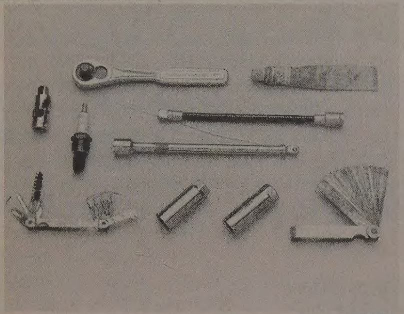
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Fig. 10 A variety of tools and gauges should be used for spark plug gapping and installation

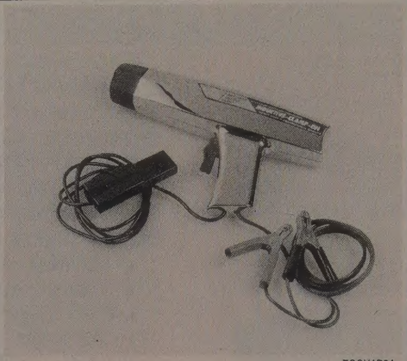
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Fig. 11 Inductive type timing light

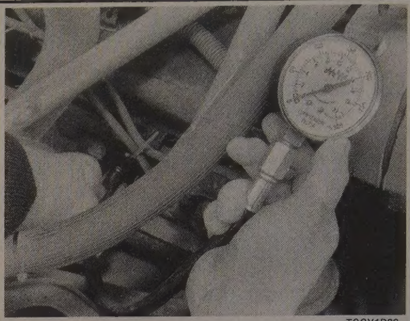
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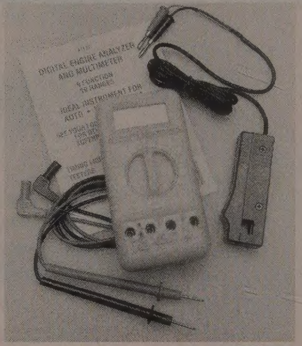
Fig. 12 A screw-in type compression gauge is recommended for compression testing

SUPER PRO
VACUUM/PRESSURE TESTER
CHECKS FUEL PUMP AND VACUUM SYSTEM
PROFESSIONAL QUALITY
TCCX1P03

Fig. 13 A vacuum/pressure tester is necessary for many testing procedures



TCCX1P06

Fig. 14 Most modern automotive multimeters incorporate many helpful features

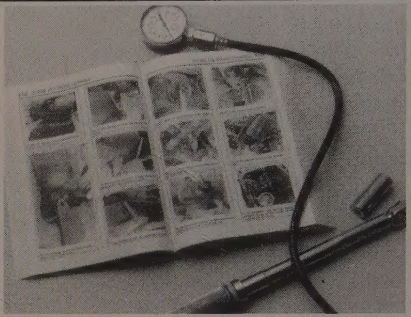

TCCS1213

Fig. 15 Proper information is vital, so always have a Chilton Total Car Care manual handy

tem, a timing light with an inductive pickup that clamps around the No. 1 spark plug cable is preferred.

In addition to these basic tools, there are several other tools and gauges you may find useful. These include:

- Compression gauge. The screw-in type is slower to use, but eliminates the possibility of a faulty reading due to escaping pressure.
- Manifold vacuum gauge.
- 12V test light.
- A combination volt/ohmmeter
- Induction Ammeter. This is used for determining whether or not there is current in a wire. These are handy for use if a wire is broken somewhere in a wiring harness.

As a final note, you will probably find a torque wrench necessary for all but the most basic work. The beam type models are perfectly adequate, although the newer click types (breakaway) are easier to use. The click type torque wrenches tend to be more expensive. Also keep in mind that all types of torque wrenches should be periodically checked and/or recalibrated. You will have to decide for yourself which better fits your pocketbook, and purpose.

Special Tools

Normally, the use of special factory tools is avoided for repair procedures, since these are not readily available for the do-it-yourself mechanic. When it is possible to perform the job with more commonly available tools, it will be pointed out, but occasionally, a special tool was designed to perform a specific function and should be used. Before substituting another tool, you should be convinced that neither your safety nor the performance of the vehicle will be compromised.

Special tools can usually be purchased from an automotive parts store or from your dealer. In some cases special tools may be available directly from the tool manufacturer.

SERVICING YOUR VEHICLE SAFELY

➧ See Figures 16, 17 and 18

It is virtually impossible to anticipate all of the hazards involved with automotive maintenance and service, but care and common sense will prevent most accidents.

The rules of safety for mechanics range from "don't smoke around gasoline," to "use the proper tool(s) for the job." The trick to avoiding injuries is to develop safe work habits and to take every possible precaution.

Do's

- Do keep a fire extinguisher and first aid kit handy.
- Do wear safety glasses or goggles when cutting, drilling, grinding or prying, even if you have 20–20 vision. If you wear glasses for the sake of vision, wear safety goggles over your regular glasses.
- Do shield your eyes whenever you work around the battery. Batteries contain sulfuric acid. In case of contact with, flush the area with water or a mixture of water and baking soda, then seek immediate medical attention.
- Do use safety stands (jackstands) for any undervehicle service. Jacks are for raising vehicles; jackstands are for making sure the vehicle stays raised until you want it to come down.
- Do use adequate ventilation when working with any chemicals or hazardous materials. Like carbon monoxide, the asbestos dust resulting from some brake lining wear can be hazardous in sufficient quantities.
- Do disconnect the negative battery cable when working on the electrical system. The secondary ignition system contains EXTREMELY HIGH VOLTAGE. In some cases it can even exceed 50,000 volts.
- Do follow manufacturer's directions whenever working with potentially hazardous materials. Most chemicals and fluids are poisonous.

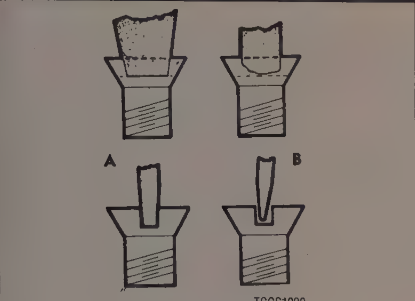


Fig. 16 Screwdrivers should be kept in good condition to prevent injury or damage which could result if the blade slips from the screw

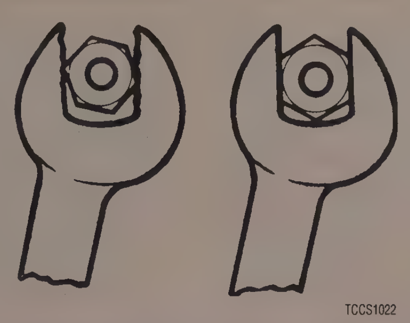


Fig. 17 Using the correct size wrench will help prevent the possibility of rounding off a nut

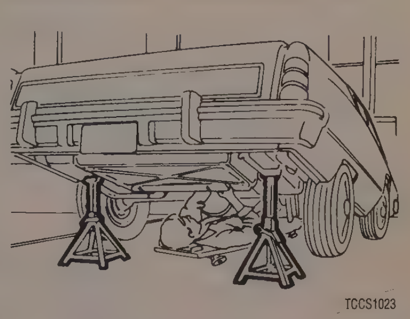


Fig. 18 NEVER work under a vehicle unless it is supported using safety stands (jackstands)

- Do properly maintain your tools. Loose hammerheads, mushroomed punches and chisels, frayed or poorly grounded electrical cords, excessively worn screwdrivers, spread wrenches (open end), cracked sockets, slipping ratchets, or faulty droplight sockets can cause accidents.
- Likewise, keep your tools clean; a greasy wrench can slip off a bolt head, ruining the bolt and often harming your knuckles in the process.
- Do use the proper size and type of tool for the job at hand. Do select a wrench or socket that fits the nut or bolt. The wrench or socket should sit straight, not cocked.
- Do, when possible, pull on a wrench handle rather than push on it, and adjust your stance to prevent a fall.
- Do be sure that adjustable wrenches are tightly closed on the nut or bolt and pulled so that the force is on the side of the fixed jaw.
- Do strike squarely with a hammer; avoid glancing blows.
- Do set the parking brake and block the drive wheels if the work requires a running engine.

Don'ts

- Don't run the engine in a garage or anywhere else without proper ventilation—EVER! Carbon monoxide is poisonous; it takes a long time to leave the human body and you can build up a deadly supply of it in your system by simply breathing in a little at a time. You may not realize you are slowly poisoning yourself. Always use power vents, windows, fans and/or open the garage door.
- Don't work around moving parts while wearing loose clothing. Short sleeves are much safer than long, loose sleeves. Hard-toed shoes with neoprene soles protect your toes and give a better grip on slippery surfaces. Watches and jewelry is not safe working around a vehicle. Long hair should be tied back under a hat or cap.
- Don't use pockets for toolboxes. A fall or bump can drive a screwdriver deep into your body. Even a rag hanging from your back pocket can wrap around a spinning shaft or fan.
- Don't smoke when working around gasoline, cleaning solvent or other flammable material.
- Don't smoke when working around the battery. When the battery is being charged, it gives off explosive hydrogen gas.
- Don't use gasoline to wash your hands; there are excellent soaps available. Gasoline contains dangerous additives which can enter the body through a cut or through your pores. Gasoline also removes all the natural oils from the skin so that bone dry hands will suck up oil and grease.
- Don't service the air conditioning system unless you are equipped with the necessary tools and training. When liquid or compressed gas refrigerant is released to atmospheric pressure it will absorb heat from whatever it contacts. This will chill or freeze anything it touches.
- Don't use screwdrivers for anything other than driving screws! A screwdriver used as an prying tool can snap when you least expect it, causing injuries. At the very least, you'll ruin a good screwdriver.
- Don't use an emergency jack (that little ratchet, scissors, or pantograph jack supplied with the vehicle) for anything other than changing a flat! These jacks are only intended for emergency use out on the road; they are NOT designed as a maintenance tool. If you are serious about maintaining your vehicle yourself, invest in a hydraulic floor jack of at least a 1½ ton capacity, and at least two sturdy jackstands.

FASTENERS, MEASUREMENTS AND CONVERSIONS

Bolts, Nuts and Other Threaded Retainers

➧ See Figures 19 and 20

Although there are a great variety of fasteners found in the modern car or truck, the most commonly used retainer is the threaded fastener (nuts, bolts, screws, studs, etc.). Most threaded retainers may be reused, provided that they are not damaged in use or during the repair. Some retainers (such as stretch bolts or torque prevailing nuts) are designed to deform when tightened or in use and should not be reinstalled.

Whenever possible, we will note any special retainers which should be replaced during a procedure. But you should always inspect the condition of a retainer when it is removed and replace any that show signs of damage. Check all threads for rust or corrosion which can increase the torque necessary to achieve the desired clamp load for which that fastener was originally selected. Additionally, be sure that the driver surface of the fastener has not been compromised by rounding or other damage. In some cases a driver surface may become only partially rounded, allowing the driver to catch in only one direction. In many of these occurrences, a fastener may be installed and tightened, but the driver would not be able to grip and loosen the fastener again.

If you must replace a fastener, whether due to design or damage, you must ALWAYS be sure to use the proper replacement. In all cases, a retainer of the

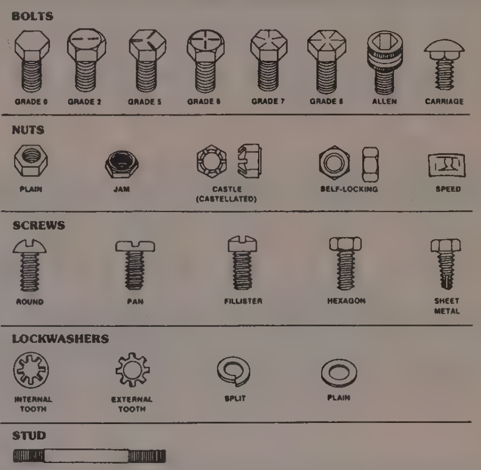


Fig. 19 There are many different types of threaded retainers found on vehicles

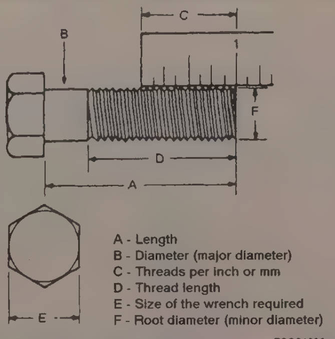

C
B
1
F
D
A
E
A - Length
B - Diameter (major diameter)
C - Threads per inch or mm
D - Thread length
E - Size of the wrench required
F - Root diameter (minor diameter)
TCCS1038

Fig. 20 Threaded retainer sizes are determined using these measurements

same design, material and strength should be used. Markings on the heads of most bolts will help determine the proper strength of the fastener. The same material, thread and pitch must be selected to assure proper installation and safe operation of the vehicle afterwards.

Thread gauges are available to help measure a bolt or stud's thread. Most automotive and hardware stores keep gauges available to help you select the proper size. In a pinch, you can use another nut or bolt for a thread gauge. If the bolt you are replacing is not too badly damaged, you can select a match by finding another bolt which will thread in its place. If you find a nut which threads properly onto the damaged bolt, then use that nut to help select the replacement bolt.

✻✻ WARNING

Be aware that when you find a bolt with damaged threads, you may also find the nut or drilled hole it was threaded into has also been damaged. If this is the case, you may have to drill and tap the hole, replace the nut or otherwise repair the threads. NEVER try to force a replacement bolt to fit into the damaged threads.

Torque

Torque is defined as the measurement of resistance to turning or rotating. It tends to twist a body about an axis of rotation. A common example of this would be tightening a threaded retainer such as a nut, bolt or screw. Measuring torque is one of the most common ways to help assure that a threaded retainer has been properly fastened.

When tightening a threaded fastener, torque is applied in three distinct areas, the head, the bearing surface and the clamp load. About 50 percent of the measured torque is used in overcoming bearing friction. This is the friction between the bearing surface of the bolt head, screw head or nut face and the base material or washer (the surface on which the fastener is rotating). Approximately 40 percent of the applied torque is used in overcoming thread friction. This leaves only about 10 percent of the applied torque to develop a useful clamp load (the force which holds a joint together). This means that friction can account for as much as 90 percent of the applied torque on a fastener.

TORQUE WRENCHES

◗ See Figure 21

In most applications, a torque wrench can be used to assure proper installation of a fastener. Torque wrenches come in various designs and most automotive supply stores will carry a variety to suit your needs. A torque wrench should be used any time we supply a specific torque value for a fastener. Again, the general rule of "if you are using the right tool for the job, you should not have to strain to tighten a fastener" applies here.

Beam Type

The beam type torque wrench is one of the most popular types. It consists of a pointer attached to the head that runs the length of the flexible beam (shaft) to a scale located near the handle. As the wrench is pulled, the beam bends and the pointer indicates the torque using the scale.

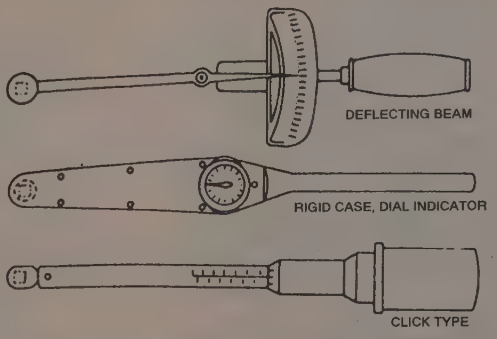


Fig. 21 Various styles of torque wrenches are usually available at your local automotive supply store

Click (Breakaway) Type

Another popular design of torque wrench is the click type. To use the click type wrench you pre-adjust it to a torque setting. Once the torque is reached, the wrench has a reflex signaling feature that causes a momentary breakaway of the torque wrench body, sending an impulse to the operator's hand.

Pivot Head Type

◗ See Figure 22

Some torque wrenches (usually of the click type) may be equipped with a pivot head which can allow it to be used in areas of limited access. BUT, it must be used properly. To hold a pivot head wrench, grasp the handle lightly, and as you pull on the handle, it should be floated on the pivot point. If the handle comes in contact with the yoke extension during the process of pulling, there is a very good chance the torque readings will be inaccurate because this could alter the wrench loading point. The design of the handle is usually such as to make it inconvenient to deliberately misuse the wrench.

➡It should be mentioned that the use of any U-joint, wobble or extension will have an effect on the torque readings, no matter what type of wrench you are using. For the most accurate readings, install the socket directly on the wrench driver. If necessary, straight extensions (which hold a socket directly under the wrench driver) will have the least effect on the torque reading. Avoid any extension that alters the length of the wrench from the handle to the head/driving point (such as a crow's foot). U-joint or wobble extensions can greatly affect the readings; avoid their use at all times.

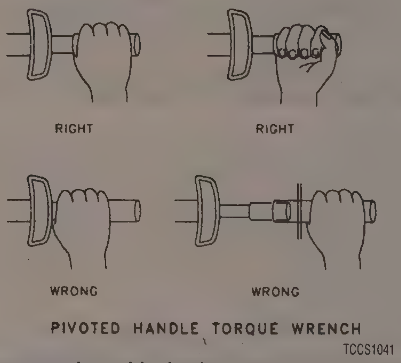


Fig. 22 Torque wrenches with pivoting heads must be grasped and used properly to prevent an incorrect reading

Rigid Case (Direct Reading)

A rigid case or direct reading torque wrench is equipped with a dial indicator to show torque values. One advantage of these wrenches is that they can be held at any position on the wrench without affecting accuracy. These wrenches are often preferred because they tend to be compact, easy to read and have a great degree of accuracy.

TORQUE ANGLE METERS

Because the frictional characteristics of each fastener or threaded hole will vary, clamp loads which are based strictly on torque will vary as well. In most applications, this variance is not significant enough to cause worry. But, in certain applications, a manufacturer's engineers may determine that more precise clamp loads are necessary (such is the case with many aluminum cylinder heads). In these cases, a torque angle method of installation would be specified. When installing fasteners which are torque angle tightened, a predetermined seating torque and standard torque wrench are usually used first to remove any compliance from the joint. The fastener is then tightened the specified additional portion of a turn measured in degrees. A torque angle gauge (mechanical protractor) is used for these applications.

Standard and Metric Measurements

➧ See Figure 23

Throughout this manual, specifications are given to help you determine the condition of various components on your vehicle, or to assist you in their installation. Some of the most common measurements include length (in. or cm/mm), torque (ft. lbs., inch lbs. or Nm) and pressure (psi, in. Hg, kPa or mm Hg). In most cases, we strive to provide the proper measurement as determined by the manufacturer's engineers.

Though, in some cases, that value may not be conveniently measured with what is available in your toolbox. Luckily, many of the measuring devices which are available today will have two scales so the Standard or Metric measurements may easily be taken. If any of the various measuring tools which are available to you do not contain the same scale as listed in the specifications, use the accompanying conversion factors to determine the proper value.

The conversion factor chart is used by taking the given specification and multiplying it by the necessary conversion factor. For instance, looking at the first line, if you have a measurement in inches such as "free-play should be 2 in." but your ruler reads only in millimeters, multiply 2 in. by the conversion factor of 25.4 to get the metric equivalent of 50.8mm. Likewise, if the specification was given only in a Metric measurement, for example in Newton Meters (Nm), then look at the center column first. If the measurement is 100 Nm, multiply it by the conversion factor of 0.738 to get 73.8 ft. lbs.

CONVERSION FACTORS

LENGTH–DISTANCE				
Inches (in.)	x 25.4	= Millimeters (mm)	x .0394	= Inches
Feet (ft.)	x .305	= Meters (m)	x 3.281	= Feet
Miles	x 1.609	= Kilometers (km)	x .0621	= Miles
VOLUME				
Cubic Inches (in3)	x 16.387	= Cubic Centimeters	x .061	= in3
IMP Pints (IMP pt.)	x .568	= Liters (L)	x 1.76	= IMP pt.
IMP Quarts (IMP qt.)	x 1.137	= Liters (L)	x .88	= IMP qt.
IMP Gallons (IMP gal.)	x 4.546	= Liters (L)	x .22	= IMP gal.
IMP Quarts (IMP qt.)	x 1.201	= US Quarts (US qt.)	x .833	= IMP qt.
IMP Gallons (IMP gal.)	x 1.201	= US Gallons (US gal.)	x .833	= IMP gal.
Fl. Ounces	x 29.573	= Milliliters	x .034	= Ounces
US Pints (US pt.)	x .473	= Liters (L)	x 2.113	= Pints
US Quarts (US qt.)	x .946	= Liters (L)	x 1.057	= Quarts
US Gallons (US gal.)	x 3.785	= Liters (L)	x .264	= Gallons
MASS–WEIGHT				
Ounces (oz.)	x 28.35	= Grams (g)	x .035	= Ounces
Pounds (lb.)	x .454	= Kilograms (kg)	x 2.205	= Pounds
PRESSURE				
Pounds Per Sq. In. (psi)	x 6.895	= Kilopascals (kPa)	x .145	= psi
Inches of Mercury (Hg)	x .4912	= psi	x 2.036	= Hg
Inches of Mercury (Hg)	x 3.377	= Kilopascals (kPa)	x .2961	= Hg
Inches of Water (H_2O)	x .07355	= Inches of Mercury	x 13.783	= H_2O
Inches of Water (H_2O)	x .03613	= psi	x 27.684	= H_2O
Inches of Water (H_2O)	x .248	= Kilopascals (kPa)	x 4.026	= H_2O
TORQUE				
Pounds–Force Inches (in–lb)	x .113	= Newton Meters (N·m)	x 8.85	= in–lb
Pounds–Force Feet (ft–lb)	x 1.356	= Newton Meters (N·m)	x .738	= ft–lb
VELOCITY				
Miles Per Hour (MPH)	x 1.609	= Kilometers Per Hour (KPH)	x .621	= MPH
POWER				
Horsepower (Hp)	x .745	= Kilowatts	x 1.34	= Horsepower
FUEL CONSUMPTION*				
Miles Per Gallon IMP (MPG)	x .354	= Kilometers Per Liter (Km/L)		
Kilometers Per Liter (Km/L)	x 2.352	= IMP MPG		
Miles Per Gallon US (MPG)	x .425	= Kilometers Per Liter (Km/L)		
Kilometers Per Liter (Km/L)	x 2.352	= US MPG		

*It is common to covert from miles per gallon (mpg) to liters/100 kilometers (1/100 km), where mpg (IMP) x 1/100 km = 282 and mpg (US) x 1/100 km = 235.

TEMPERATURE

Degree Fahrenheit (°F) = (°C x 1.8) + 32
Degree Celsius (°C) = (°F – 32) x .56

TCCS1044

Fig. 23 Standard and metric conversion factors chart

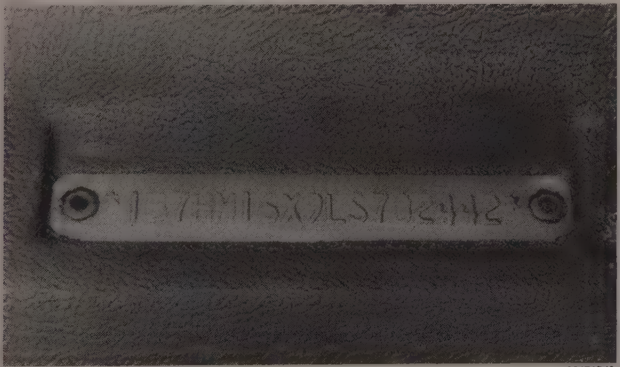
SERIAL NUMBER IDENTIFICATION

Vehicle

➧ See Figures 24 and 25

The Vehicle Identification Number (VIN) is located on the instrument panel close to the windshield on the driver's side of the vehicle. It is visible from outside the vehicle. This 17 character label contains such information as manufacturer name, month and year of manufacture, type of restraint system, body type, engine, etc. The VIN is used for title and registration purposes.

The 10th character of the VIN designates the year the vehicle was built. For example, the code indicating the model year for a truck with the VIN 1B7GE06Y5MS100001 would be the 10th character "M." The model year indicated by "M" is 1991. Each year covered by this manual has a different letter-based code beginning with "B" in 1981. The model codes proceed in order through the alphabet: "C" is for 1982, "D" is for 1983, "E" is for 1984, etc. The exceptions to this rule are letters such as "I," "O" or "Q" which are not used in order to avoid confusion with numbers.



88471P42

Fig. 24 The VIN is found on a plate affixed to the dash board and is visible through the windshield

Engine

➧ See Figure 26

The 8th character of the VIN designates the engine type installed in the vehicle. All engines have a serial number stamped on a pad on the right side of the block.

Transmission

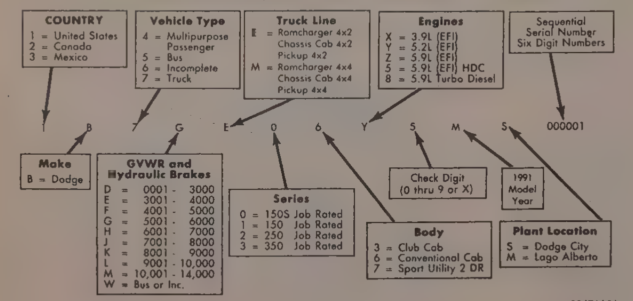
The transmission identification number is located on a tag secured by two bolts to the power take-off cover.

Drive Axle

The drive axle code is found stamped on a flat surface on the axle tube, next to the differential housing, or on a tag secured by one of the differential housing cover bolts. This code designates the axle ratio.

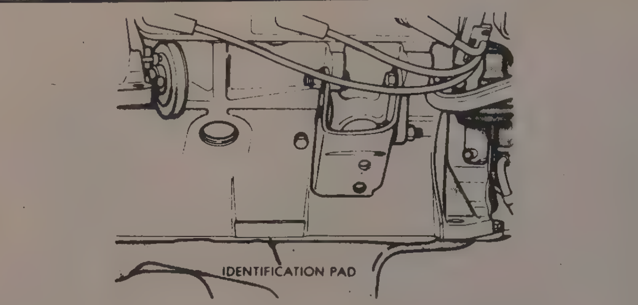
Transfer Case

The New Process transfer cases have a build date tag attached to the front of the case.


COUNTRY
1 = United States
2 = Canada
3 = Mexico
Vehicle Type
4 = Multipurpose Passenger
5 = Bus
6 = Incomplete
7 = Truck
Truck Line
E = Ramcharger 4x2 Chassis Cab 4x2 Pickup 4x2
M = Ramcharger 4x4 Chassis Cab 4x4 Pickup 4x4
Engines
X = 3.9L (EFI)
Y = 5.2L (EFI)
Z = 5.9L (EFI)
5 = 5.9L (EFI) HDC
8 = 5.9L Turbo Diesel
Sequential Serial Number Six Digit Numbers
1 B 7 G E 0 6 Y 5 M S 000001
Make
B = Dodge
GVWR and Hydraulic Brakes
D = 0001 - 3000
E = 3001 - 4000
F = 4001 - 5000
G = 5001 - 6000
H = 6001 - 7000
J = 7001 - 8000
K = 8001 - 9000
L = 9001 - 10,000
M = 10,001 - 14,000
W = Bus or Inc.
Series
0 = 150S Job Rated
1 = 150 Job Rated
2 = 250 Job Rated
3 = 350 Job Rated
Check Digit (0 thru 9 or X)
1991 Model Year
Body
3 = Club Cab
6 = Conventional Cab
7 = Sport Utility 2 DR
Plant Location
S = Dodge City
M = Lago Alberto

88471A01

Fig. 25 Vehicle identification number decoding


IDENTIFICATION PAD

88471004

Fig. 26 All engine identification numbers are stamped onto the block in this location

ENGINE IDENTIFICATION

All measurements are given in inches.

Year	Model	Engine Displacement Liters (cc)	Engine Series (ID/VIN)	Fuel System	No. of Cylinders	Engine Type
1989	D/W 150 Pick-up	3.9 (3916)	X	TBI	6	OHV
	D/W 150 Pick-up	5.2 (5211)	Y	TBI	8	OHV
	D/W 150 Pick-up	5.9 (5899)	Z	TBI	8	OHV
	D/W 150 Pick-up	5.9 (5899)	W	4BC	8	OHV
	D250 Pick-up	3.9 (3916)	X	TBI	6	OHV
	D/W 250 Pick-up	5.2 (5211)	Y	TBI	8	OHV
	D/W 250 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 250 Pick-up	5.9 (5899)	Z	TBI	8	OHV
	D/W 250 Pick-up	5.9 (5899)	W	4BC	8	OHV
	D/W 350 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 350 Pick-up	5.9 (5899)	Z	TBI	8	OHV
	D/W 350 Pick-up	5.9 (5899)	W	4BC	8	OHV
	Ramcharger	5.2 (5211)	Y	TBI	8	OHV
	Ramcharger	5.9 (5899)	Z	TBI	8	OHV
	Ramcharger	5.9 (5899)	W	4BC	8	OHV
	Dakota	2.5 (2507)	K	TBI	4	SOHC
	Dakota	3.9 (3916)	X	TBI	6	OHV
1990	D/W 150 Pick-up	3.9 (3916)	X	TBI	6	OHV
	D/W 150 Pick-up	5.2 (5211)	Y	TBI	8	OHV
	D/W 150 Pick-up	5.9 (5899)	Z	TBI	8	OHV
	D250 Pick-up	3.9 (3916)	X	TBI	6	OHV
	D/W 250 Pick-up	5.2 (5211)	Y	TBI	8	OHV
	D/W 250 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 250 Pick-up	5.9 (5899)	Z	TBI	8	OHV
	D/W 350 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 350 Pick-up	5.9 (5899)	5	TBI	8	OHV
	Ramcharger	5.2 (5211)	Y	TBI	8	OHV
	Ramcharger	5.9 (5899)	5	TBI	8	OHV
	Ramcharger	5.9 (5899)	Z	TBI	8	OHV
	Dakota	2.5 (2507)	K	TBI	4	SOHC
	Dakota	3.9 (3916)	X	TBI	6	OHV
1991	D/W 150 Pick-up	3.9 (3916)	X	TBI	6	OHV
	D/W 150 Pick-up	5.2 (5211)	Y	TBI	8	OHV
	D/W 150 Pick-up	5.9 (5899)	Z	TBI	8	OHV
	D 250 Pick-up	3.9 (3916)	X	TBI	6	OHV
	D/W 250 Pick-up	5.2 (5211)	Y	TBI	8	OHV
	D/W 250 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 250 Pick-up	5.9 (5899)	Z	TBI	8	OHV
	D/W 350 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 350 Pick-up	5.9 (5899)	5	TBI	8	OHV
	Ramcharger	5.2 (5211)	Y	TBI	8	OHV
	Ramcharger	5.9 (5899)	Z	TBI	8	OHV
	Dakota	2.5 (2507)	K	TBI	4	SOHC
	Dakota	3.9 (3916)	X	TBI	6	OHV
	Dakota	5.2 (5211)	Y	TBI	8	OHV

88471C04

ENGINE IDENTIFICATION

All measurements are given in inches.

Year	Model	Engine Displacement Liters (cc)	Engine Series (ID/VIN)	Fuel System	No. of Cylinders	Engine Type
1992	D/W 150 Pick-up	3.9 (3916)	X	MFI	6	OHV
	D/W 150 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 150 Pick-up	5.9 (5899)	Z	TBI	8	OHV
	D 250 Pick-up	3.9 (3916)	X	MFI	6	OHV
	D/W 250 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 250 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 250 Pick-up	5.9 (5899)	Z	TBI	8	OHV
	D/W 350 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 350 Pick-up	5.9 (5899)	5	TBI	8	OHV
	Ramcharger	5.2 (5211)	Y	MFI	8	OHV
	Ramcharger	5.9 (5899)	Z	TBI	8	OHV
	Dakota	2.5 (2507)	K	TBI	4	SOHC
	Dakota	3.9 (3916)	X	MFI	6	OHV
	Dakota	5.2 (5211)	Y	MFI	8	OHV
1993	D/W 150 Pick-up	3.9 (3916)	X	MFI	6	OHV
	D/W 150 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 150 Pick-up	5.9 (5899)	Z	MFI	8	OHV
	D 250 Pick-up	3.9 (3916)	X	MFI	6	OHV
	D/W 250 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 250 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 250 Pick-up	5.9 (5899)	Z	MFI	8	OHV
	D/W 350 Pick-up	5.9 (5882)	8	DSL	6	OHV
	D/W 350 Pick-up	5.9 (5899)	5	MFI	8	OHV
	Ramcharger	5.2 (5211)	Y	MFI	8	OHV
	Ramcharger	5.9 (5899)	Z	MFI	8	OHV
	Dakota	2.5 (2507)	K	TBI	4	SOHC
	Dakota	3.9 (3916)	X	MFI	6	OHV
	Dakota	5.2 (5211)	Y	MFI	8	OHV
1994	D 1500 Pick-up	3.9 (3916)	X	MFI	6	OHV
	D/W 1500 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 1500 Pick-up	5.9 (5899)	Z	MFI	8	OHV
	D/W 2500 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 2500 Pick-up	5.9 (5882)	C	DSL	6	OHV
	D/W 2500 Pick-up	5.9 (5899)	Z	MFI	8	OHV
	D/W 2500 Pick-up	8.0 (7997)	W	MFI	10	OHV
	D/W 3500 Pick-up	5.9 (5882)	C	DSL	6	OHV
	D/W 3500 Pick-up	5.9 (5899)	5	MFI	8	OHV
	D/W 3500 Pick-up	8.0 (7997)	W	MFI	10	OHV
	Dakota	2.5 (2507)	K	TBI	4	SOHC
	Dakota	3.9 (3916)	X	MFI	6	OHV
	Dakota	5.2 (5211)	Y	MFI	8	OHV

88471C05

ENGINE IDENTIFICATION

All measurements are given in inches.

Year	Model	Engine Displacement Liters (cc)	Engine Series (ID/VIN)	Fuel System	No. of Cylinders	Engine Type
1995	D 1500 Pick-up	3.9 (3916)	X	MFI	6	OHV
	D/W 1500 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 1500 Pick-up	5.9 (5899)	Z	MFI	8	OHV
	D/W 2500 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 2500 Pick-up	5.9 (5882)	C	DSL	6	OHV
	D/W 2500 Pick-up	5.9 (5899)	Z	MFI	8	OHV
	D/W 2500 Pick-up	8.0 (7997)	W	MFI	10	OHV
	D/W 3500 Pick-up	5.9 (5882)	C	DSL	6	OHV
	D/W 3500 Pick-up	5.9 (5899)	5	MFI	8	OHV
	D/W 3500 Pick-up	8.0 (7997)	W	MFI	10	OHV
	Dakota	2.5 (2507)	G	TBI	4	SOHC
	Dakota	3.9 (3916)	X	MFI	6	OHV
	Dakota	5.2 (5211)	Y	MFI	8	OHV
1996	D 1500 Pick-up	3.9 (3916)	X	MFI	6	OHV
	D/W 1500 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 1500 Pick-up	5.9 (5899)	Z	MFI	8	OHV
	D/W 2500 Pick-up	5.2 (5211)	Y	MFI	8	OHV
	D/W 2500 Pick-up	5.9 (5882)	C	DSL	6	OHV
	D/W 2500 Pick-up	5.9 (5899)	Z	MFI	8	OHV
	D/W 2500 Pick-up	8.0 (7997)	W	MFI	10	OHV
	D/W 3500 Pick-up	5.9 (5882)	C	DSL	6	OHV
	D/W 3500 Pick-up	5.9 (5899)	5	MFI	8	OHV
	D/W 3500 Pick-up	8.0 (7997)	W	MFI	10	OHV
	Dakota	2.5 (2507)	G	MFI	4	SOHC
	Dakota	3.9 (3916)	X	MFI	6	OHV
	Dakota	5.2 (5211)	Y	MFI	8	OHV

DSL - Diesel
4BC- Four Barrel Carburetor
MFI - Multi-port Fuel Injection
TBI - Throttle Body Fuel Injection
OHV - Overhead Valve
SOHC - Single Overhead Camshaft

88471C06

ROUTINE MAINTENANCE AND TUNE-UP

Proper maintenance and tune-up is the key to long and trouble-free vehicle life. Studies have shown that a properly tuned and maintained vehicle can achieve better gas mileage than an out-of-tune vehicle. As a conscientious owner and driver, set aside a Saturday morning, say once a month, to check or replace items which could cause major problems later. Keep your own personal log to jot down which services you performed, how much the parts cost you, the date, and the exact odometer reading at the time. Keep all receipts for such items as engine oil and filters, so that they may be referred to in case of related problems or to determine operating expenses. As a do-it-yourselfer, these receipts are the only proof you have that the required maintenance was performed. In the event of a warranty problem, these receipts will be invaluable.

The literature provided with your vehicle when it was originally delivered includes the factory recommended maintenance schedule. If you no longer have this literature, replacement copies are usually available from the dealer.

Refer to the maintenance interval charts later in this section for recommended service intervals.

Air Cleaner

REMOVAL & INSTALLATION

All 1989–93 Ram and 1989–96 Dakota Models

➧ See Figures 27, 28, 29 and 30

The air cleaner element is a traditional dry paper element. The air cleaner element should be replaced every 30 months or 30,000 miles (48,000 km). The diesel engine air filter should be cleaned every 6000 miles (9600 km) and replaced every 18,000 miles (28,800 km). More frequent changes are necessary if the vehicle is operated in dusty conditions.

1. Remove the top from the air cleaner and remove the wrapper (if equipped). If the optional white polyester wrapper is used, do not attempt to wash it with solvent. The factory recommends it be left dry.
2. Carefully clean the filter element by blowing it out with compressed air from the inside out. Do not immerse the paper element in liquid. If the paper element is saturated for more than ½ of its circumference by oil from the wrapper, the element should be replaced and the rest of the crankcase ventilating system checked for proper function.
3. Wash inside the housing with a suitable solvent, then wipe dry with a lint-free cloth.

To install:

4. Position the filter in the housing and fasten the cover in place.
5. Tighten the wingnut to 15 inch lbs. (1.5 Nm). If the housing-to-throttle body mounting stud is being installed, tighten to 90 inch lbs. (10 Nm).

1994–96 3.9L, 5.2L and 5.9L Gasoline Powered Ram Models

➧ See Figure 31

➡To prevent damage to the air filter housing, the entire housing must be removed from the engine for filter replacement.

1. Remove the air inlet tube.
2. Loosen, but do not remove the band-type screw clamp.
3. Disconnect the breather hose at the rear of the filter housing.
4. If equipped with the Heavy Duty Cycle (HDC) 5.9L engine, detach the air pump hose at the filter housing.
5. Lift the assembly from the throttle body while slipping it also from the mounting stud. (Pay attention to this as it will be used to properly position the assembly upon installation.)
6. Check the condition of the gasket at the throttle body and replace as necessary.
7. Unlatch the three spring clips and tilt the cover up and rearward, then remove the cover.

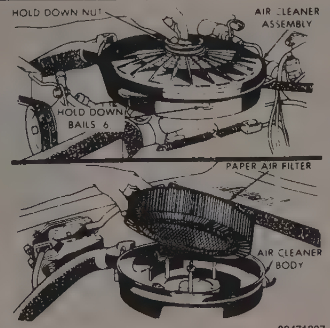


Fig. 27 Remove the hold-down nut and release the cover bails to access the air cleaner element

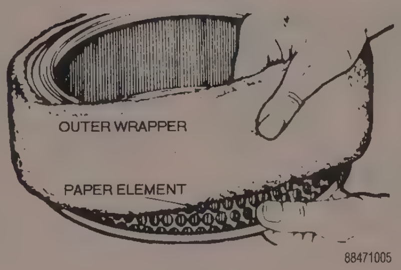


Fig. 28 Remove the wrapper (optional) from the air filter element for inspection

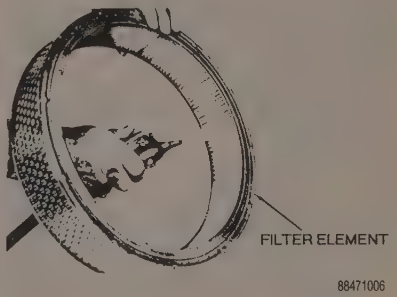


Fig. 29 Use compressed air to clean the element from the inside out

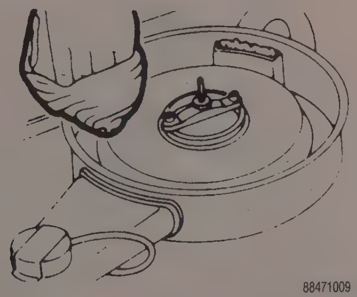


Fig. 30 Use a lint-free cloth to wipe clean and dry the inside of the air filter housing

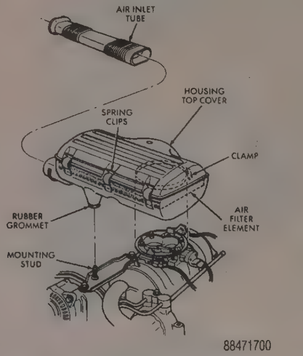


Fig. 31 Exploded view of the air filter housing assembly—3.9L, 5.2L, 5.9L gasoline-powered engines

8. Remove the filter element.

To install:

9. Clean the inside of the housing with a lint-free cloth, and solvent, if necessary.
10. Install the filter element in the housing and install the housing. (Remember to position the rubber grommet onto the mounting stud.)
11. Push down on the assembly to seat it. Tighten the clamp to 15 inch lbs. (2 Nm).
12. Install the air inlet tube at the filter housing inlet. If working on the HDC 5.9L engine, attach the air pump hose.

8.0L Engine

➧ See Figures 32 thru 38

1. Loosen the clamp, then remove the air inlet tube.
2. Unlatch the spring clips from the filter cover, then remove the cover.
3. Remove the air filter element.

To install:

4. Clean the inside of the air filter housing so it is free of oil and debris.
5. Install the air filter element in the housing, then latch the cover.
6. Install the air inlet tube and clamp it in place.

1994–96 Diesel Engines

➧ See Figures 39 and 40

➡The diesel engines are equipped with a Filter Minder™ gauge. The ratcheting yellow disc inside registers the highest restriction the filter element has experienced during engine operation. Do not unnecessarily remove the top of the filter housing unless the scale on the Filter Minder™ indicates it is time to do so.

1. Remove the air inlet tube.
2. Unlatch the four spring clips and tilt the cover up and forward, then remove the cover.

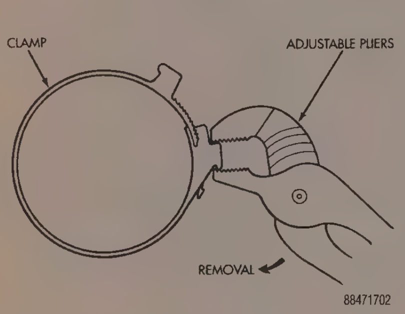

CLAMP
ADJUSTABLE PLIERS
REMOVAL
88471702

Fig. 32 Use adjustable pliers as shown to loosen the air inlet tube clamp

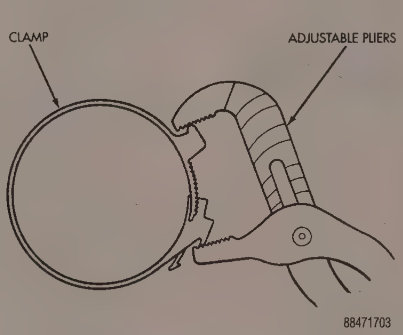

CLAMP
ADJUSTABLE PLIERS
88471703

Fig. 33 To tighten the air inlet tube clamp, use adjustable pliers as shown

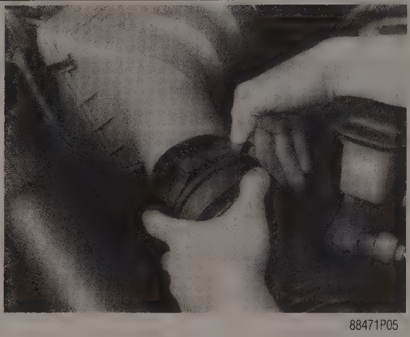


Fig. 34 Loosen the air inlet tube clamp and position the tube out of the way—V10 engine

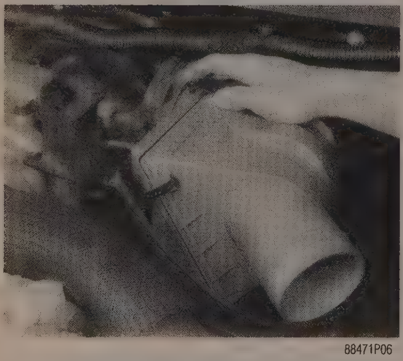


Fig. 35 Loosen the clamps to separate the air filter housing

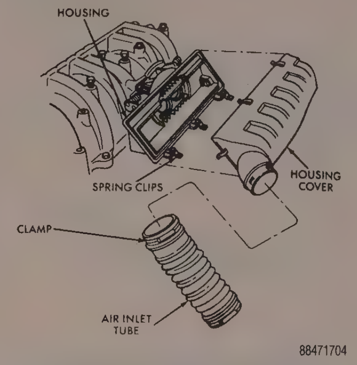

HOUSING
HOUSING COVER
SPRING CLIPS
CLAMP
AIR INLET TUBE
88471704

Fig. 36 Exploded view of the air filter assembly—8.0L engines

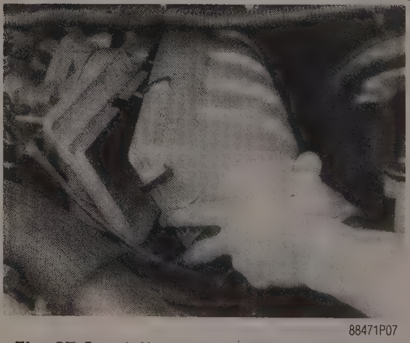


Fig. 37 Carefully remove the top of the air filter housing to access the air cleaner element

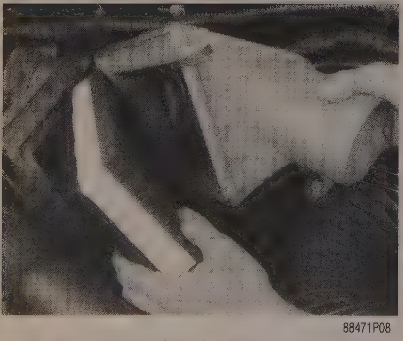


Fig. 38 Remove the air cleaner element from the housing for inspection or replacement

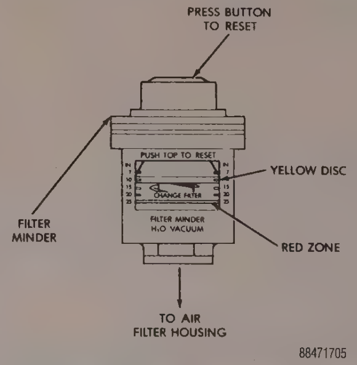

PRESS BUTTON TO RESET
PUSH TOP TO RESET
IN
7
10
15
20
25
CHANGE FILTER
FILTER MINDER
H2O VACUUM
YELLOW DISC
FILTER MINDER
RED ZONE
TO AIR FILTER HOUSING
88471705

Fig. 39 Details of the Filter Minder™ used on 1994–96 diesel engines

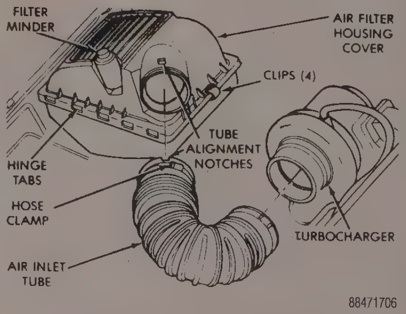

FILTER MINDER
AIR FILTER HOUSING COVER
CLIPS (4)
TUBE ALIGNMENT NOTCHES
HINGE TABS
HOSE CLAMP
TURBOCHARGER
AIR INLET TUBE
88471706

Fig. 40 Exploded view of the air filter assembly—1994–96 diesel engines

3. Remove the air filter element.

To install:

4. Clean the inside of the air filter housing so it is free of oil and debris.
5. Install the air filter element in the housing, then latch the cover.
6. Install the air inlet tube and tighten the clamp to 25 inch lbs. (3 Nm).

Fuel Filter

REMOVAL & INSTALLATION

⁂ CAUTION

Never smoke when working around gasoline! Avoid all sources of sparks or ignition. Gasoline vapors are EXTREMELY volatile!

All 1989–93 Gasoline Engines and 1994–96 2.5L Engines

➧ See Figure 41

The fuel filter is located in the fuel line on the inside of the left frame rail, just ahead of the crossmember.

1. Relieve the fuel system pressure as described in Section 5.
2. Unfasten the filter retaining screw and remove the filter from the frame rail.
3. Wrap a shop towel around the hose connections to catch fuel spillage. Loosen the fuel hose clamps and disconnect the hoses from the filter.
4. Remove the old fuel filter and replace it with a new one.
5. Connect the fuel hoses and tighten the hose clamps. Position the filter on the frame rail and tighten the retaining screw to 75 inch lbs. (8 Nm).

1994–96 Gasoline Engines—Except 2.5L

➧ See Figures 42, 43 and 44

The fuel filter is integrated into the fuel pressure regulator which is mounted in the fuel tank. This unit is not controlled by the PCM or engine vacuum. It is calibrated to deliver approximately 35–45 psi (241–310 kPa) of fuel pressure to the injectors. If the pressure exceeds the maximum of the specified range, an internal diaphragm closes to route fuel back into the fuel tank. This system eliminates the need for conventional return lines from the engine bay and accounts for the name of the "Returnless" fuel injection system employed in these vehicles.

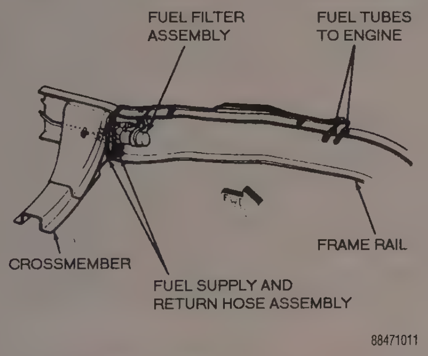


Fig. 41 Fuel filter location for gasoline engines

➡Fuel tank removal is required for this procedure. Also needed will be external snapring pliers and proper hose clamp pliers, such as No. C-4124 pliers (available through Plymouth/Dodge dealers), or equivalent.

1. Relieve the fuel system pressure as described in Section 5.
2. Drain the fuel tank and remove the tank.
3. Remove the fuel filter/regulator (which is pressed into a rubber grommet) by twisting and pulling it straight up.
4. Remove the snapring retaining the cover tube, then slide it down to reveal the clear plastic fuel tube and its retaining clamp.
5. Gently cut off the old clamp without damaging the tube, then discard the clamp.
6. Carefully pull the tube off, then remove the filter/regulator from the fuel pump module.

To install:

7. Install a new clamp over the plastic fuel tube and attach it loosely to the filter/regulator. Rotate the unit in the line until it is pointed to the driver's side of the vehicle.
8. Tighten the clamp using hose clamp pliers such as No. C-4124 (available through the Plymouth/Dodge dealer).

➡Do not use conventional side cutters to tighten the clamp.

9. Slide the cover tube up to the bottom of the filter/regulator and install the snapring.
10. Carefully press the assembly back into the rubber grommet by hand. It should be pointed to the driver's side of the vehicle.
11. Install the fuel tank.

PCV Valve

➧ See Figures 45, 46 and 47

➡All gasoline engines covered by this manual are equipped with Positive Crankcase Ventilation (PCV) systems.

The crankcase emission control equipment consists of a Positive Crankcase Ventilation (PCV) valve, a closed oil filler cap and the hoses that connect this equipment.

When the engine is running, a small portion of gases which are formed in the combustion chamber leak by the piston rings entering the crankcase. Since these gases are under pressure they tend to escape the crankcase and enter into the atmosphere. If the gases are allowed to remain in the crankcase for any length of time, they would contaminate the engine oil and cause sludge to build. If the gases are allowed to escape into the atmosphere, they would pollute the air, as they contain unburned hydrocarbons. The crankcase ventilation system recycles these gases back into the combustion chambers, where they are burned.

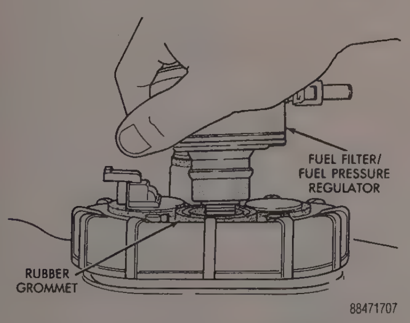


Fig. 42 With the fuel tank removed, twist and pull the fuel filter/regulator for removal from the rubber mounting grommet

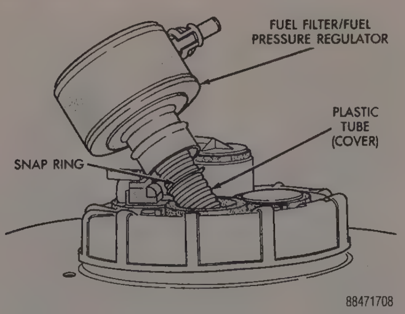


Fig. 43 Use snapring pliers to remove the retainer securing the cover tube to the base of the filter/regulator

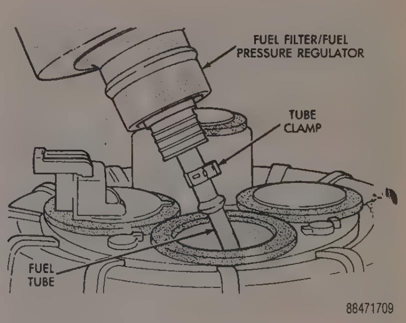


Fig. 44 Cut off the old tube clamp without damaging the plastic fuel tube

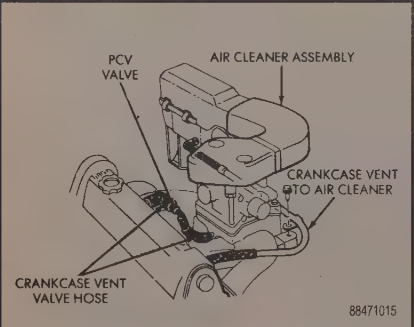


Fig. 45 Components of the 2.5L engine PCV system

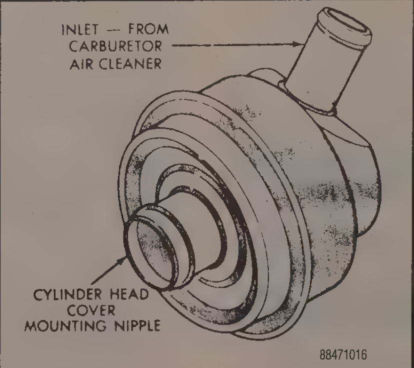


Fig. 46 The crankcase inlet filter

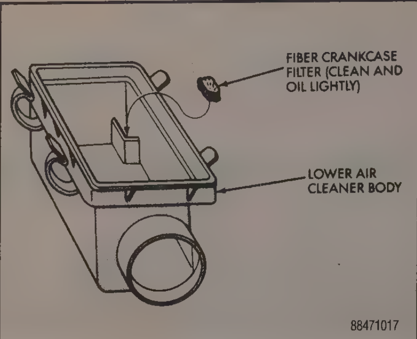


Fig. 47 Location of the crankcase filter on the 2.5L engine

Crankcase gases are recycled in the following manner. While the engine is running, clean filtered air is drawn into the crankcase through the intake air filter and then through a hose leading to the oil filler cap. As the air passes through the crankcase it picks up the combustion gases and carries them out of the crankcase, up through the PCV valve and into the intake manifold. After they enter the intake manifold they are drawn into the combustion chamber and are burned.

The most critical component of the system is the PCV valve. This vacuum-controlled valve regulates the amount of gases which are recycled into the combustion chamber. At low engine speeds the valve is partially closed, limiting the flow of gases into the intake manifold. As engine speed increases, the valve opens to admit greater quantities of the gases into the intake manifold.

If the valve should become blocked or plugged, the gases will be prevented from escaping the crankcase by the normal route. Since these gases are under pressure, they will find their own way out of the crankcase. This alternate route is usually a weak oil seal or gasket in the engine. As the gas escapes by the gasket, it also creates an oil leak. Besides causing oil leaks, a clogged PCV valve also allows these gases to remain in the crankcase for an extended period of time, promoting the formation of sludge in the engine.

REMOVAL & INSTALLATION

➧ See Figures 48 and 49

1. Pull the PCV valve and hose from the rubber grommet in the rocker cover.
2. Remove the PCV valve from the hose.
3. Inspect the inside of the valve hose. If it is dirty, disconnect it from the intake manifold and clean it with a safe solvent.

➡Do not attempt to clean a PCV valve. If you suspect it is not working, replace it.

To install:

4. If the PCV valve hose was removed, connect it to the intake manifold.
5. Connect the PCV valve to its hose.
6. Install the PCV valve into the rubber grommet in the valve (rocker) cover.

Evaporative Canister

➧ See Figures 50 and 51

The EVAP control system prevents gasoline vapors from escaping into the atmosphere. When fuel evaporates from the fuel tank, the vapors pass through vent hoses or tubes to the carbon-filled EVAP canister. They are temporarily held in the canister until they can be drawn into the intake manifold when the engine is running.

The vapors are drawn into the engine at idle as well as when the engine is operating above idle speed. This system is called a Bi-Level Purge System where there is a dual source of vacuum to remove the vapor from the EVAP canister.

➡The hoses used in this system are specifically manufactured. If replacement becomes necessary, it is important to use only fuel resistant hose.

The EVAP canister itself is sealed and maintenance-free. It is used on all gasoline-powered vehicles (only) and is mounted to the left frame rail; below the left side of the truck; near the left door. The EVAP canister is serviced as one complete unit (not including the bracket. The canister is purged by the EVAP canister purge solenoid at predetermined times and certain engine operating conditions.

The EVAP canister purge solenoid controls the vacuum that draws the vapors from the canister. The solenoid is controlled by the Single Module Engine Controller (SMEC) for 1989–93 models. For 1994–96 models, it is controlled by the Powertrain Control Module (PCM). The PCM operates the solenoid by either switching the ground circuit on or off. When energized the solenoid prevents vacuum from reaching the EVAP canister. When not energized, the solenoid allows vacuum to flow to the EVAP canister. The purge solenoid is mounted to a bracket located near the left-rear side of the intake manifold.

The solenoid opens when the engine reaches normal operating temperature and the vehicle is moving.

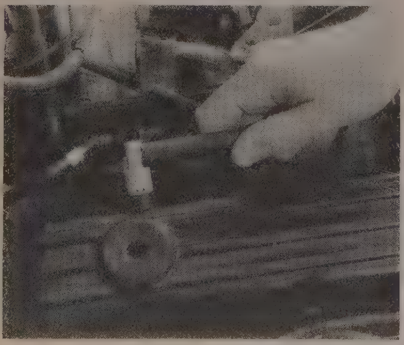


Fig. 48 Pull the PCV valve out from the rubber grommet in the rocker cover

Fig. 49 Separate the PCV valve from the hose

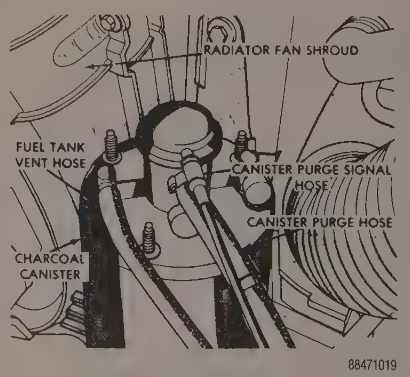


Fig. 50 The Dakota EVAP canister

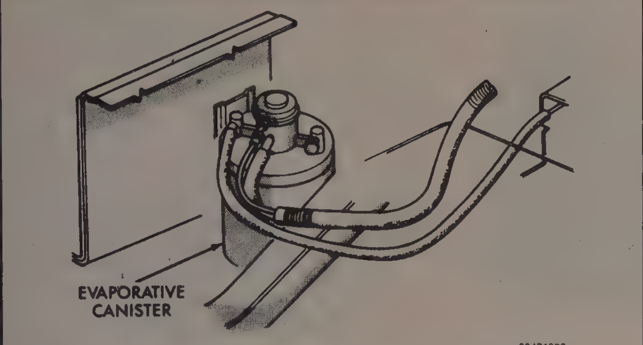


Fig. 51 A common (maintenance-free) charcoal EVAP canister—Ram trucks

SERVICING

The EVAP canister is sealed and maintenance-free. However, a periodic inspection of the unit and vent hoses is advisable. Although the factory does not give recommendations here, you should inspect the unit at least every six months or 6000 miles (9600 km). During your inspection, make sure the unit is mounted firmly in its bracket, that it is not cracked and that the vent hoses are connected and not cracked. Correct any problems you may discover, or refer to the removal and installation procedure in Section 4 if you suspect the unit itself is malfunctioning.

Battery

PRECAUTIONS

Always use caution when working on or near the battery. Never allow a tool to bridge the gap between the negative and positive battery terminals. Also, be careful not to allow a tool to provide a ground between the positive cable/terminal and any metal component on the vehicle. Either of these conditions will cause a short circuit, leading to sparks and possible personal injury.

Do not smoke or all open flames/sparks near a battery; the gases contained in the battery are very explosive and, if ignited, could cause severe injury or death.

All batteries, regardless of type, should be carefully secured by a battery hold-down device. If not, the terminals or casing may crack from stress during vehicle operation. A battery which is not secured may allow acid to leak, making it discharge faster. The acid can also eat away at components under the hood.

Always inspect the battery case for cracks, leakage and corrosion. A white corrosive substance on the battery case or on nearby components would indicate a leaking or cracked battery. If the battery is cracked, it should be replaced immediately.

GENERAL MAINTENANCE

Always keep the battery cables and terminals free of corrosion. Check and clean these components about once a year.

Keep the top of the battery clean, as a film of dirt can help discharge a battery that is not used for long periods. A solution of baking soda and water may be used for cleaning, but be careful to flush this off with clear water. DO NOT let any of the solution into the filler holes. Baking soda neutralizes battery acid and will de-activate a battery cell.

Batteries in vehicles which are not operated on a regular basis can fall victim to parasitic loads (small current drains which are constantly drawing current from the battery). Normal parasitic loads may drain a battery on a vehicle that is in storage and not used for 6–8 weeks. Vehicles that have additional accessories such as a phone or an alarm system may discharge a battery sooner. If the vehicle is to be stored for longer periods in a secure area and the alarm system is not necessary, the negative battery cable should be disconnected to protect the battery.

Remember that constantly deep cycling a battery (completely discharging and recharging it) will shorten battery life.

BATTERY FLUID

➧ See Figure 52

Check the battery electrolyte level at least once a month, or more often in hot weather or during periods of extended vehicle operation. On non-sealed batteries, the level can be checked either through the case (if translucent) or by removing the cell caps. The electrolyte level in each cell should be kept filled to the split ring inside each cell, or the line marked on the outside of the case.

If the level is low, add only distilled water through the opening until the level is correct. Each cell must be checked and filled individually. Distilled water should be used, because the chemicals and minerals found in most drinking water are harmful to the battery and could significantly shorten its life.

If water is added in freezing weather, the vehicle should be driven several miles to allow the water to mix with the electrolyte. Otherwise, the battery could freeze.

Although some maintenance-free batteries have removable cell caps, the electrolyte condition and level on all sealed maintenance-free batteries must be checked using the built-in hydrometer "eye." The exact type of eye will vary. But, most battery manufacturers, apply a sticker to the battery itself explaining the readings.

➡Although the readings from built-in hydrometers will vary, a green eye usually indicates a properly charged battery with sufficient fluid level. A dark eye is normally an indicator of a battery with sufficient fluid, but which is low in charge. A light or yellow eye usually indicates that electrolyte has dropped below the necessary level. In this last case, sealed batteries with an insufficient electrolyte must usually be discarded.

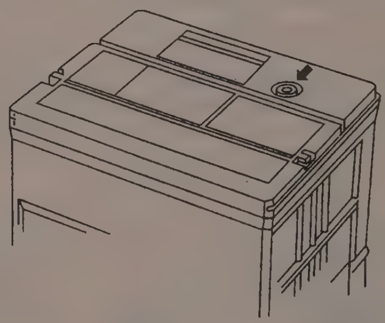


Fig. 52 Maintenance-free batteries usually contain a built-in hydrometer to check fluid level

Checking the Specific Gravity

➧ See Figures 53, 54 and 55

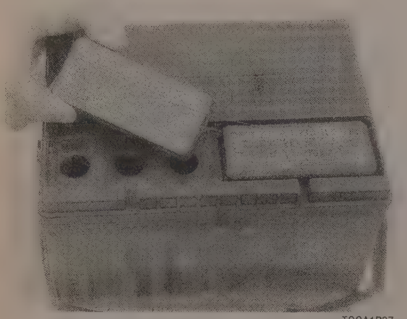
A hydrometer is required to check the specific gravity on all batteries that are not maintenance-free. On batteries that are maintenance-free, the specific gravity is checked by observing the built-in hydrometer "eye" on the top of the battery case.

✱✱ CAUTION

Battery electrolyte contains sulfuric acid. If you should splash any on your skin or in your eyes, flush the affected area with plenty of clear water. If it lands in your eyes, get medical help immediately.

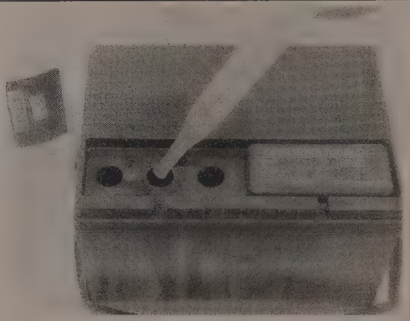
The fluid (sulfuric acid solution) contained in the battery cells will tell you many things about the condition of the battery. Because the cell plates must be kept submerged below the fluid level in order to operate, the fluid level is extremely important. And, because the specific gravity of the acid is an indication of electrical charge, testing the fluid can be an aid in determining if the battery must be replaced. A battery in a vehicle with a properly operating charging system should require little maintenance, but careful, periodic inspection should reveal problems before they leave you stranded.

At least once a year, check the specific gravity of the battery. It should be between 1.20 and 1.26 on the gravity scale. Most auto stores carry a variety of inexpensive battery hydrometers. These can be used on any non-sealed battery to test the specific gravity in each cell.



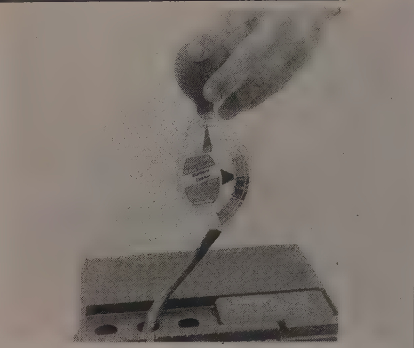
TCCA1P07

Fig. 53 On non-sealed batteries, the fluid level can be checked by removing the cell caps



TCCA1P08

Fig. 54 If the fluid level is low, add only distilled water until the level is correct



TCCA1P09

Fig. 55 Check the specific gravity of the battery's electrolyte with a hydrometer

The battery testing hydrometer has a squeeze bulb at one end and a nozzle at the other. Battery electrolyte is sucked into the hydrometer until the float is lifted from its seat. The specific gravity is then read by noting the position of the float. If gravity is low in one or more cells, the battery should be slowly charged and checked again to see if the gravity has come up. Generally, if after charging, the specific gravity between any two cells varies more than 50 points (0.50), the battery should be replaced, as it can no longer produce sufficient voltage to guarantee proper operation.

CABLES

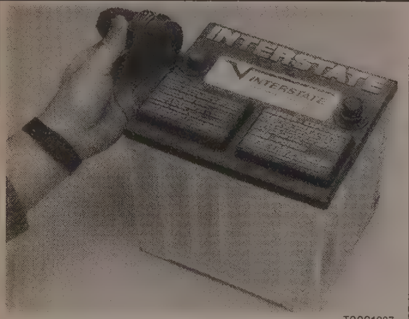
➧ See Figures 56, 57, 58 and 59

Once a year (or as necessary), the battery terminals and the cable clamps should be cleaned. Loosen the clamps and remove the cables, negative cable first. On top post batteries, the use of a puller specially made for this purpose is recommended. These are inexpensive and available in most parts stores. Side terminal battery cables are secured with a small bolt.

Clean the cable clamps and the battery terminal with a wire brush, until all corrosion, grease, etc., is removed and the metal is shiny. It is especially important to clean the inside of the clamp thoroughly (an old knife is useful here), since a small deposit of oxidation there will prevent a sound connection and inhibit starting or charging. Special tools are available for cleaning these parts, one type for conventional top post batteries and another type for side terminal batteries. It is also a good idea to apply some dielectric grease to the terminal, as this will aid in the prevention of corrosion.

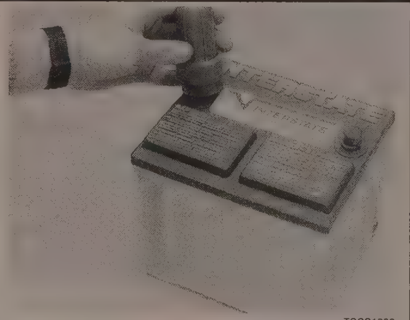
After the clamps and terminals are clean, reinstall the cables, negative cable last; DO NOT hammer the clamps onto battery posts. Tighten the clamps securely, but do not distort them. Give the clamps and terminals a thin external coating of grease after installation, to retard corrosion.

Check the cables at the same time that the terminals are cleaned. If the cable insulation is cracked or broken, or if the ends are frayed, the cable should be replaced with a new cable of the same length and gauge.



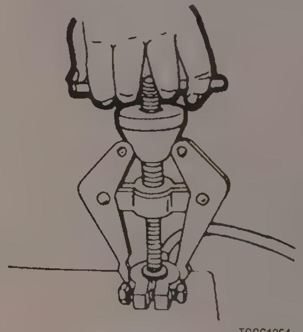
TCCS1207

Fig. 56 The underside of this special battery tool has a wire brush to clean post terminals



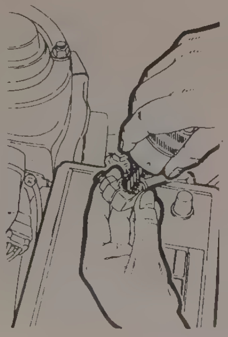
TCCS1208

Fig. 57 Place the tool over the battery posts and twist to clean until the metal is shiny



TCCS1254

Fig. 58 A special tool is available to pull the clamp from the post



TCCS1256

Fig. 59 The cable ends should be cleaned as well

CHARGING

✱✱ CAUTION

The chemical reaction which takes place in all batteries generates explosive hydrogen gas. A spark can cause the battery to explode and splash acid. To avoid personal injury, be sure there is proper ventilation and take appropriate fire safety precautions when working with or near a battery.

A battery should be charged at a slow rate to keep the plates inside from getting too hot. However, if some maintenance-free batteries are allowed to discharge until they are almost "dead," they may have to be charged at a high rate to bring them back to "life." Always follow the charger manufacturer's instructions on charging the battery.

REPLACEMENT

When it becomes necessary to replace the battery, select one with an amperage rating equal to or greater than the battery originally installed. Deterioration and just plain aging of the battery cables, starter motor, and associated wires makes the battery's job harder in successive years. This makes it prudent to install a new battery with a greater capacity than the old.

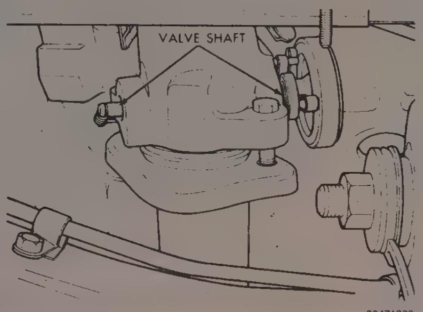
Heat Riser

Every 30,000 miles (48,000 km) the heat riser valve should be checked for free operation and lubricated with penetrating oil.

SERVICING

➧ See Figure 60

The valve is located on the exhaust manifold near the point that the exhaust pipe is attached to the manifold. Try to turn the counterweight manually. If it is stuck, tap the end of the shaft a few times with a hammer. Apply penetrating oil to the shaft ends and work back-and-forth a few times. If the valve is still stuck and cannot be loosened with oil or heat (use a propane torch), it will have to be replaced.



88471260

Fig. 60 Lubricate the manifold heat riser at the valve shaft

Belts

INSPECTION

➧ See Figures 61 thru 66

➡Trucks equipped with an automatic belt tensioner DO need their belts inspected as normal. However, for those trucks so equipped, you may disregard recommendations for belt adjustment. Be sure to inspect/replace the belts at the proper intervals, or as needed.

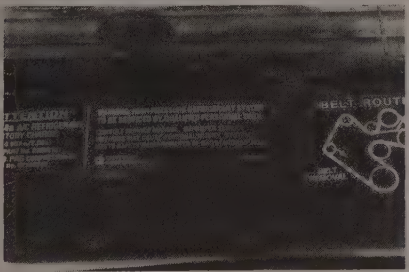
Once a year or at 12,000 mile (19,000 km) intervals, the tension (and condition) of the alternator, power steering, air conditioning, and air pump drive belts (as equipped) should be checked. Inspect the belts for signs of glazing or cracking. A glazed belt will be perfectly smooth from slippage, while a good belt will have a slight texture of fabric visible. Cracks will usually start at the inner edge of the belt and run outward. It is always best to replace all drive belts at one time, as a preventive maintenance measure, during this service operation.

Loose accessory drive belts can lead to poor engine cooling and diminish alternator, power steering pump, air conditioning compressor or air pump output. A belt that is too tight places a severe strain on the bearings of the components it is driving which will lead to early component failure.

There are two different types of belts that may be found on your truck, V-belts (single ribbed) and serpentine type (multi-ribbed). Both of these types may drive one or more accessories.

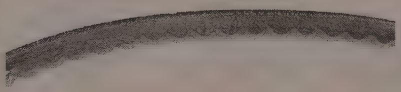
➡The material used in late model drive belts is such that the belts do not show wear as readily. Replace belts at least every three years.

On vehicles with matched belts, replace both belts. New ½ in. (13mm), ⅜ in. (9.5mm) and 15/32 in. (12mm) wide belts are to be adjusted to a tension of 135 lbs. (600 N), and ¼ in. (6mm) wide belts are to be adjusted to 80 lbs. (336 N), as measured on a belt tension gauge. Any belt that has been operating for a minimum of 10 minutes is considered a used belt. In the first 10 minutes, the belt should stretch to its maximum extent. After 10 minutes, stop the engine and recheck the belt tension. Belt tension for a used belt should be maintained at 110 lbs. (490 N) for all except ¼ in. (6mm) wide belts, and at 60 lbs. (267 N) for ¼ in. (6mm) wide belts. If a belt tension gauge is not available, the following procedures may be used.



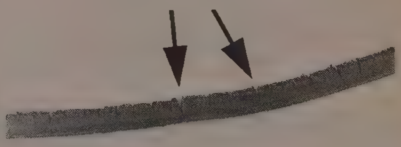
88471P00

Fig. 61 Look at the label affixed to the radiator support to determine correct serpentine belt routing



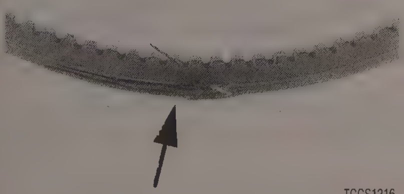
TCCS1214

Fig. 62 An example of a healthy drive belt



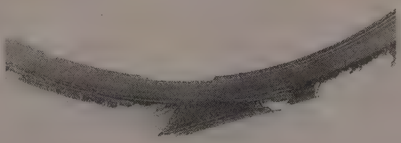
TCCS1215

Fig. 63 The deep cracks in this belt will cause it to flex, build up heat and eventually fail



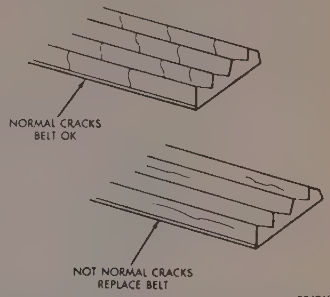
TCCS1216

Fig. 64 Roughness in one or more of the pulleys can cause critical belt wear down to the reinforcing cords



TCCS1217

Fig. 65 Installing a belt that is too wide will result in premature belt wear and eventual failure



88471034

Fig. 66 Serpentine drive belt wear patterns

ADJUSTMENTS

See Figures 67 thru 76

➡Trucks equipped with an automatic belt tensioner do NOT need to have their belts adjusted. Be sure, however, to inspect/replace the belts at the proper intervals.

CAUTION

If equipped, the electrically operated cooling fan may come on under certain circumstances, even though the ignition is OFF. Be sure to disconnect the negative battery cable before servicing your vehicle.

Alternator Belt

See Figures 77, 78 and 79

1. Position a ruler perpendicular to the drive belt at its longest straight run. Test the tightness of the belt by pressing it firmly with your thumb. The deflection should be ¼–5⁄16 in. (6–8mm).
2. If the deflection exceeds these limits, loosen the alternator mounting and adjusting arm bolts.
3. Place a 1 in. open-end or adjustable wrench on the adjusting ridge cast on the body, and pull on the wrench until the proper tension is achieved.
4. Holding the alternator in place to maintain tension, tighten the adjusting arm bolt. Recheck the belt tension; readjust if necessary. When the belt is properly tensioned, tighten the alternator mounting bolt.

Power Steering

4-CYLINDER ENGINES

1. Hold a ruler perpendicular to the drive belt at its longest run, test the tightness of the belt by pressing it firmly with your thumb. The deflection should be ¼ in. to 5⁄16 in. (6–8mm).
2. To adjust the belt tension, loosen the adjusting and mounting bolts on the front face of the steering pump cover plate (hub side).
3. Insert a ½ in. breaker bar into the adjusting bracket and apply pressure until the belt tension is correct.
4. Holding the pump in place, tighten the adjusting arm bolt and then recheck the belt tension. When the belt is properly tensioned tighten the mounting bolts.

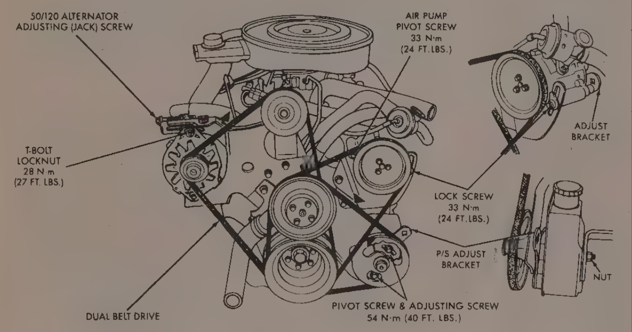

50/120 ALTERNATOR ADJUSTING (JACK) SCREW
AIR PUMP PIVOT SCREW 33 N·m (24 FT. LBS.)
ADJUST BRACKET
T-BOLT LOCKNUT 28 N·m (27 FT. LBS.)
LOCK SCREW 33 N·m (24 FT. LBS.)
P/S ADJUST BRACKET
NUT
DUAL BELT DRIVE
PIVOT SCREW & ADJUSTING SCREW 54 N·m (40 FT. LBS.)
88471030

Fig. 67 Accessory drive belts and adjustment locations—3.9L V6 engine

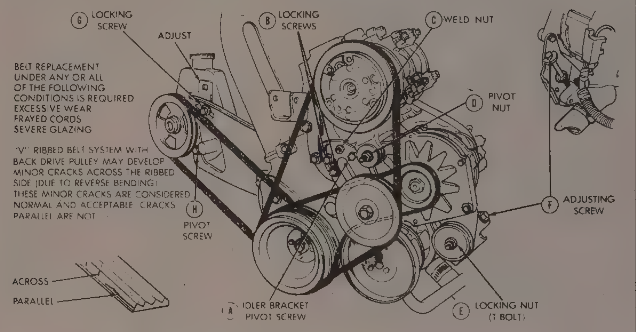

G LOCKING SCREW
ADJUST
B LOCKING SCREWS
C WELD NUT
BELT REPLACEMENT UNDER ANY OR ALL OF THE FOLLOWING CONDITIONS IS REQUIRED EXCESSIVE WEAR FRAYED CORDS SEVERE GLAZING
"V" RIBBED BELT SYSTEM WITH BACK DRIVE PULLEY MAY DEVELOP MINOR CRACKS ACROSS THE RIBBED SIDE (DUE TO REVERSE BENDING) THESE MINOR CRACKS ARE CONSIDERED NORMAL AND ACCEPTABLE. CRACKS PARALLEL ARE NOT
D PIVOT NUT
H PIVOT SCREW
F ADJUSTING SCREW
ACROSS
PARALLEL
A IDLER BRACKET PIVOT SCREW
E LOCKING NUT (T BOLT)
88471031

Fig. 68 Accessory drive belts and adjustment locations—2.5L 4-cylinder engine

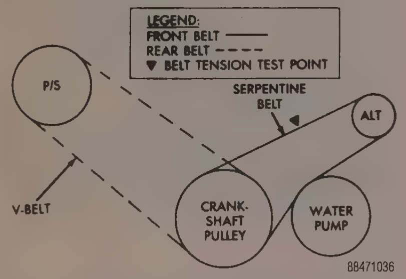

LEGEND:
FRONT BELT
REAR BELT
▼ BELT TENSION TEST POINT
P/S
SERPENTINE BELT
ALT
V-BELT
CRANK-SHAFT PULLEY
WATER PUMP
88471036

Fig. 69 Belt tension test points and routing of accessory drive belts—2.5L engine without air conditioning

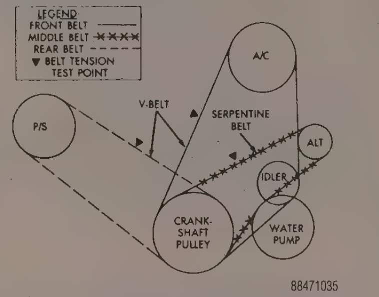

LEGEND
FRONT BELT
MIDDLE BELT
REAR BELT
▼ BELT TENSION TEST POINT
A/C
P/S
V-BELT
SERPENTINE BELT
ALT
IDLER
CRANK-SHAFT PULLEY
WATER PUMP
88471035

Fig. 70 Belt tension test points and routing of accessory drive belts—2.5L engine with air conditioning

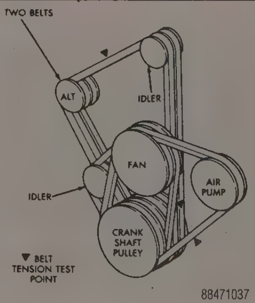

TWO BELTS
ALT
IDLER
FAN
AIR PUMP
IDLER
CRANK SHAFT PULLEY
▼ BELT TENSION TEST POINT
88471037

Fig. 71 Belt tension test points and routing of accessory drive belts—3.9L engine without air conditioning or power steering

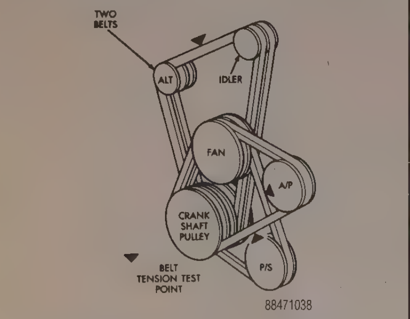

TWO BELTS
ALT
IDLER
FAN
A/P
CRANK SHAFT PULLEY
P/S
▼ BELT TENSION TEST POINT
88471038

Fig. 72 Belt tension test points and routing of accessory drive belts—3.9L engine without air conditioning

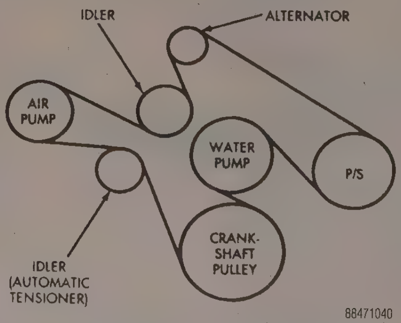

IDLER
ALTERNATOR
AIR PUMP
WATER PUMP
P/S
CRANK-SHAFT PULLEY
IDLER (AUTOMATIC TENSIONER)
88471040

Fig. 73 Serpentine belt routing—5.2L engine without air conditioning

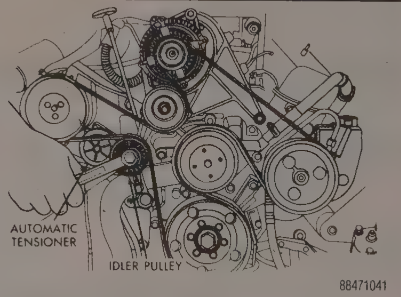
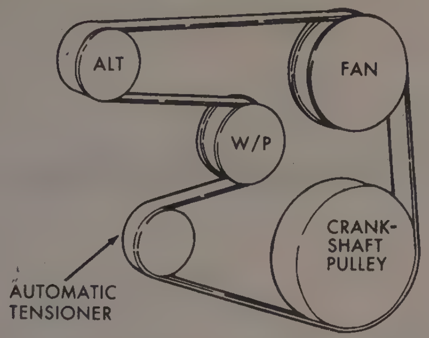
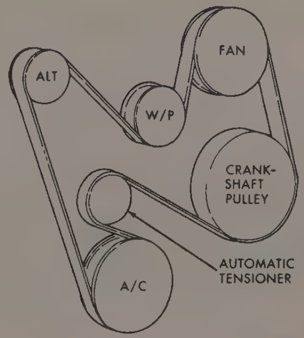

AUTOMATIC TENSIONER
IDLER PULLEY
88471041

Fig. 74 For engines with automatic tensioners, turn the idler pulley clockwise to relieve belt tension—5.2L V8 engine shown, others similar



88471042

Fig. 75 Serpentine belt routing—5.9L diesel engine without air conditioning



88471043

Fig. 76 Serpentine belt routing—5.9L diesel engine with air conditioning

88471P38

Fig. 77 Loosen the alternator mounting bolt

88471P39

Fig. 78 Loosen the alternator adjusting arm bolt

88471P40

Fig. 79 Turn the adjuster to achieve the proper tension

V6 AND V8 ENGINES

1. Position a ruler perpendicular to the drive belt at its longest run. Test the tightness of the belt by pressing it firmly with your thumb. The deflection should be ¼–5⁄16 in. (6–8mm).
2. To adjust the belt tension, loosen the three bolts in the three elongated adjusting slots at the power steering pump attaching bracket.
3. Turn the steering pump drive belt adjusting nut as required until the proper deflection is obtained. Turning the adjusting nut clockwise will increase tension and decrease deflection; counterclockwise will decrease tension and increase deflection.
4. Without disturbing the pump, tighten the three attaching bolts.

Air Conditioning Compressor

1. Position a ruler perpendicular to the drive belt at its longest run. Test the tightness of the belt by pressing it firmly with your thumb. The deflection should be ¼–5⁄16 in. (6–8mm).
2. If the engine is equipped with an idler pulley, loosen the idler pulley adjusting bolt, insert a pry bar wrapped with a rag, between the pulley and the engine (or in the idler pulley adjusting slot), and adjust the tension accordingly. If the engine is not equipped with an idler pulley, the alternator must be moved to accomplish this adjustment, as outlined under Alternator Belt.
3. When the proper tension is reached, tighten the idler pulley adjusting bolt or the alternator adjusting and mounting bolts, as equipped.

Air Pump

1. Position a ruler perpendicular to the drive belt at its longest run. Test the tightness of the belt by pressing it firmly with your thumb. The deflection should be ¼–5⁄16 in. (6–8mm).
2. To adjust the belt tension, loosen the adjusting arm bolt slightly. If necessary, also loosen the mounting belt slightly.
3. Using a large wooden dowel or a pry bar wrapped with a rag to protect the pump from damage, carefully pry against the pump rear cover to move the pump toward or away from the engine as necessary.

✲✲ WARNING

Do not pry against the pump housing itself, as damage to the housing may result.

4. Holding the pump in place, tighten the adjusting arm bolt and recheck the tension. When the belt is properly tensioned, tighten the mounting bolt.

✲✲ WARNING

Check to make sure that the V-ribbed belt is located properly in all drive pulleys before applying tensioner pressure.

REMOVAL & INSTALLATION

➧ See Figures 80 and 81

On most vehicles, to remove and install a new belt, you will need to loosen the mounting bracket bolts of the component. Using a suitable pry tool wrapped with a towel or rag, carefully pry the component forward slightly to give easy access to slide the belt off and on. You may need to do this an additional component(s) in order to make removal or installation easier. Some models have a few belts running different accessories; if you must replace a belt in the rear, you will first have to remove the belt(s) that are in your way. Look at your truck first to decide how many belts require removal to access the belt in need of replacement.

For those vehicles equipped with an automatic belt tensioner, the same logic in accessing the belt applies. To remove a belt on these vehicles, use a socket or wrench to rotate the tensioner pulley and loosen the belt. To install, place the belt over all pulleys but the tensioner pulley, then back off the tensioner in the same manner and slip the belt over the tensioner pulley. When you release the tensioner, it is spring loaded and will automatically apply the correct tension to the belt.

Timing Belts

INSPECTION

➡This procedure applies only to the 2.5L engine used in the Dakota which uses a timing belt. All other engines use a timing chain.

Every 30,000 miles (48,000 km) inspect and adjust the timing belt as necessary. Every 60,000 miles (96,000 km) replace the timing belt. When examining the timing belt, look for cracks, missing teeth and wear on any of the surfaces. Inspect the sprockets for grease and other deposits. If any of these conditions exist, the belt should be replaced. Please refer to Section 3 for procedures on timing belt removal and installation.

Hoses

INSPECTION

▶ See Figures 82, 83, 84 and 85

CAUTION

On models equipped with an electric cooling fan, disconnect the negative battery cable or fan motor wiring harness connector, before replacing any radiator/heater hose. The fan may come on, under certain circumstances, even though the ignition is OFF.

Upper and lower radiator hoses along with the heater hoses should be checked for deterioration, leaks and loose hose clamps at least every 15,000 miles (24,000 km). Early spring and at the beginning of the fall or winter, when you are performing other maintenance, are good times to perform the inspection. Make sure the engine and cooling system are cold. Visually inspect for cracking, rotting or collapsed hoses, replace as necessary. Run your hand along the length of the hose. If a weak or swollen spot is noted when squeezing the hose wall, replace the hose.

REMOVAL & INSTALLATION

CAUTION

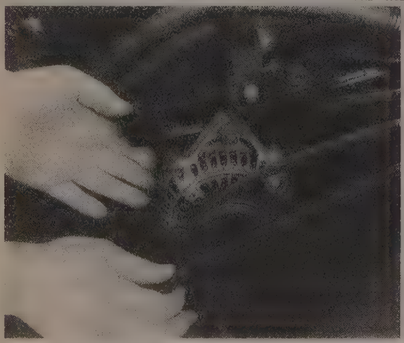
Never remove the pressure cap while the engine is running or personal injury from scalding hot coolant or steam may result. If possible, wait until the engine has cooled to remove the pressure cap. If this is not possible, wrap a thick cloth around the pressure cap and turn it slowly to the stop. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, still using the cloth, turn and remove the cap.

1. Drain the cooling system into a suitable container (if the coolant is to be reused, make sure the container is clean) by loosening the draincock on the bottom of the radiator.

CAUTION

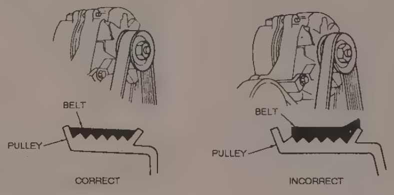
When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container. Coolant should be reused unless it is contaminated or several years old.

2. Loosen the hose clamps at each end of the hose that requires replacement.
3. Twist, pull and slide the hose off the radiator, water pump, thermostat or heater connection.



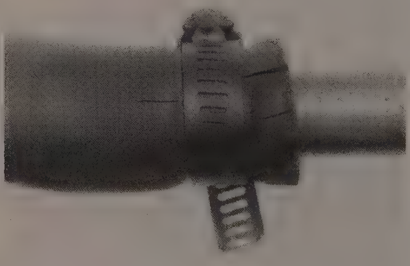
88471P41

Fig. 80 For non-serpentine V-belts, loosen the adjuster, then remove the belt(s)



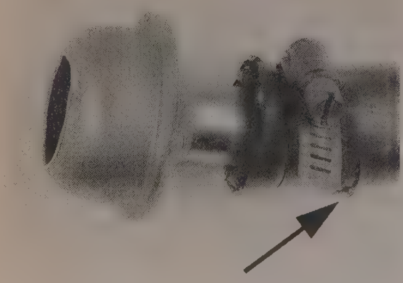
88471044

Fig. 81 Make sure the serpentine belt is correctly placed on the parallel-running teeth on all the pulleys



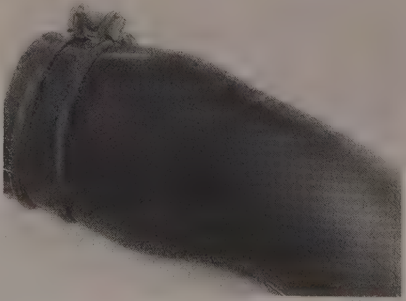
TCCS1219

Fig. 82 The cracks developing along this hose are a result of age and hardening



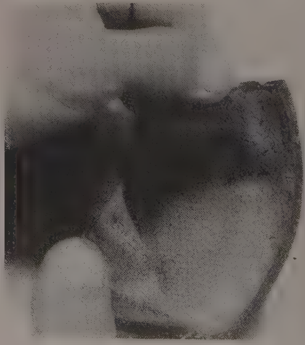
TCCS1220

Fig. 83 A hose clamp that is too tight can cause older hoses to separate and tear



TCCS1221

Fig. 84 A soft, spongy hose like this is identifiable by the swollen section near the clamp



TCCS1222

Fig. 85 Debris in the coolant can weaken the hose from the inside

➡If the hose is stuck at the connection, do not try to insert a screwdriver or other sharp tool under the hose end in an effort to free it, as the connection and/or hose may become damaged. Heater connections especially may be easily damaged by such a procedure. If the hose is to be replaced, use a single-edged razor blade to make a slice along the portion of the hose which is stuck on the connection, perpendicular to the end of the hose. Do not cut deep so as to prevent damaging the connection. The hose can then be peeled from the connection and discarded.

4. Clean both hose mounting connections. Inspect the condition of the hose clamps and replace them, if necessary.

To install:

5. Dip the ends of the new hose into clean engine coolant to ease installation.
6. Position the clamps on the new hose.
7. Coat the connection surfaces with a water resistant sealer and slide the hose into position. Make sure the hose clamps are located beyond the raised bead of the connector (if equipped) and centered in the clamping area of the connection.
8. Tighten the clamps to 20–30 inch lbs. (2–3 Nm). Do not overtighten.
9. Be sure the radiator draincock is closed, then fill the cooling system.

✱✱ CAUTION

If you are checking for leaks with the system at normal operating temperature, BE EXTREMELY CAREFUL not to touch any moving or hot engine parts. Once temperature has been reached, shut the engine OFF, and check for leaks around the hose fittings and connections which were removed earlier.

10. Start the engine and allow it to reach normal operating temperature. Check for leaks.

CV-Boots

The Constant Velocity (CV) joint boot encloses the constant velocity (CV) joint, a critical component of your front-wheel-drive car. The CV-joints are flexible couplings on each end (inner and outer) of the halfshafts. They allow the halfshafts to adjust to up-and-down and back-and-forth movements of the suspension and steering while simultaneously transmitting the engine's power to the front wheels. A CV-joint is more complex than a traditional universal joint as it must allow the wheels to turn smoothly under driving and braking loads. Because CV-joints are precision machined parts, they must be packed in lubricating grease and sealed from road grime in a protective rubber boot.

If a CV-boot tears, it will quickly let dirt enter the joint at the same time its grease is spun out onto the undercarriage and road. Thus contaminated, the under-lubricated joint will quickly wear and deteriorate. For this reason, the boots should be periodically inspected.

INSPECTION

► See Figures 86 and 87

The proper way to inspect CV-boots with the vehicle raised and supported on jackstands. Rotate the front wheels slowly one at a time while looking at and feeling the texture of the boots for cracks and tears.

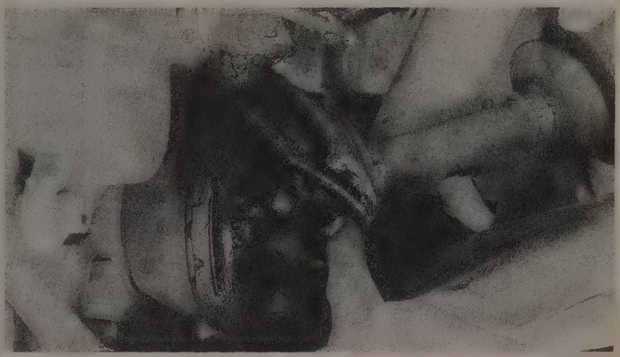
✱✱ CAUTION

Always wear appropriate eye protection while under the vehicle.

This inspection should be performed every time the vehicle is raised for any kind of service (such as oil and filter changes). If a CV-boot has a tear or is starting to crack and look worn, replace it. In the case of an already torn boot, you will want to inspect the joint itself. For information on these procedures, see Section 7, under CV-Joint and CV-Boot Removal & Installation.

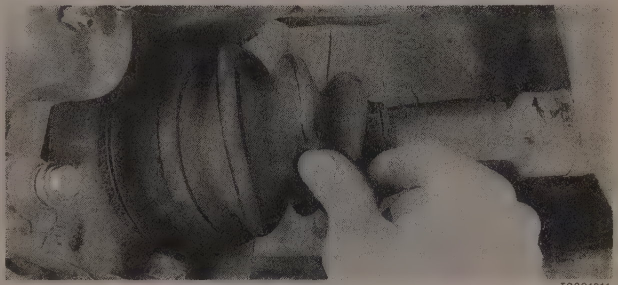
Spark Plugs

A common spark plug consists of a metal shell surrounding a ceramic insulator. A metal electrode extends downward through the center of the insulator and protrudes a small distance. Located at the end of the plug and attached to the side of the outer metal shell is the side electrode. The side electrode bends in at a 90° angle so that its tip is even with, and parallel to, the tip of the center electrode. The distance between these two electrodes (measured in thousandths of an inch) is called the spark plug gap. The spark plug in no way produces a spark, but merely provides a gap across which the current can arc. The coil produces anywhere from 20,000 to 40,000 volts which travels to the distributor, where it is distributed through the spark plug wires to the spark plugs. The current passes along the center electrode and jumps the gap to the side electrode; in so doing, it ignites the air/fuel mixture in the combustion chamber.



TCCS1010

Fig. 86 This boot is torn and must be replaced immediately



TCCS1011

Fig. 87 This boot is still in good condition

HEAT RANGE

Spark plug heat range is the ability of the plug to dissipate heat. The longer the insulator (or the farther it extends into the engine), the hotter the plug will operate; the shorter the insulator, the cooler it will operate. A plug that absorbs little heat and remains too cool will quickly accumulate deposits of oil and carbon, since it is not hot enough to burn them off. This leads to plug fouling and consequently to misfiring. A plug that absorbs too much heat will have no deposits, but, due to the excessive heat, the electrodes will burn away quickly and in some instances, pre-ignition may result. Pre-ignition takes place when plug tips get so hot that they glow sufficiently to ignite the fuel/air mixture before the actual spark occurs. This early ignition will usually cause a pinging during low speeds and heavy loads.

The general rule of thumb for selecting the correct heat range when choosing a spark plug is: if most of your driving is long distance, high speed travel, use a colder plug; if most of your driving is stop-and-go, use a hotter plug. Original equipment plugs are compromise plugs, but most people never have occasion to change their plugs from the factory-recommended heat range.

REMOVAL & INSTALLATION

► See Figures 88 thru 94

➡Spark plugs do not foul by themselves! Check for what has caused the plug to foul. Installing new spark plugs will not correct a fouling condition.

A set of spark plugs usually requires replacement after about 20,000–30,000 miles (32,180–48,270 km), depending on your style of driving. In normal operation, plug gap increases about 0.001 in. (0.025mm) for every 1,000–2,500 miles (1,690–4,022 km). As the gap increases, the plug's voltage requirement also increases. It requires a greater voltage to jump the wider gap and about two-to-three times as much voltage to fire a plug at high speeds than at idle.

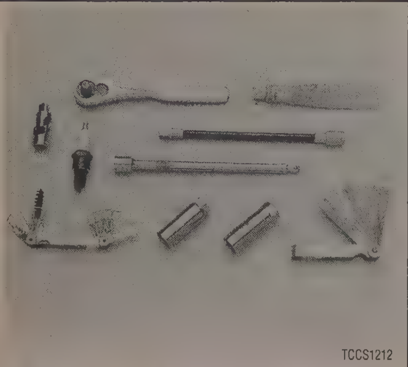

TCCS1212

Fig. 88 A variety of tools and gauges are needed for spark plug service

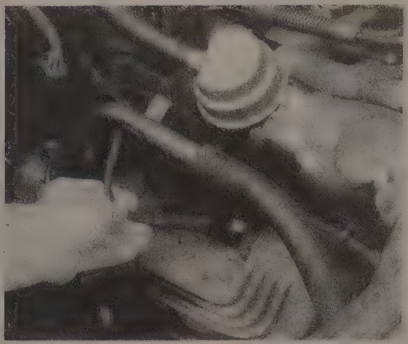

88471P21

Fig. 89 Remove the spark plug boot to access the plug

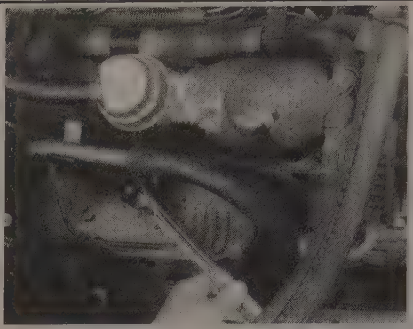
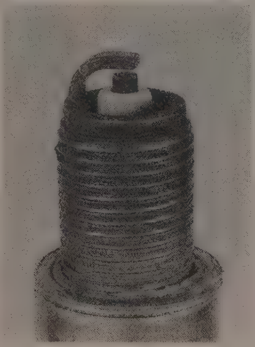
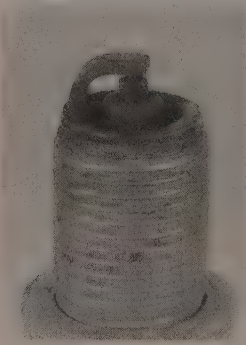
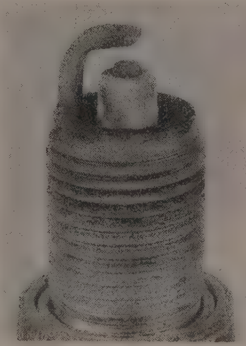
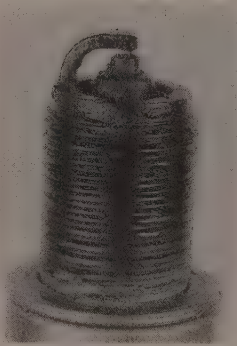

88471P22

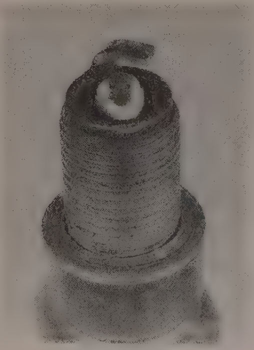
Fig. 90 Use a spark plug wrench to unscrew and remove the plug from the cylinder head

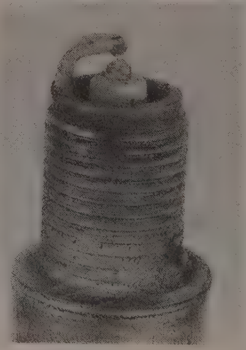

A normally worn spark plug should have light tan or gray deposits on the firing tip.


A carbon fouled plug, identified by soft, sooty, black deposits, may indicate an improperly tuned vehicle. Check the air cleaner, ignition components and engine control system.


This spark plug has been **left in the engine too long**, as evidenced by the extreme gap- Plugs with such an extreme gap can cause misfiring and stumbling accompanied by a noticeable lack of power.

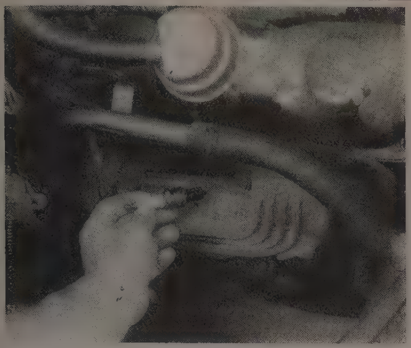

An oil fouled spark plug indicates an engine with worn poston rings and/or bad valve seals allowing excessive oil to enter the chamber.


A physically damaged spark plug may be evidence of severe detonation in that cylinder. Watch that cylinder carefully between services, as a continued detonation will not only damage the plug, but could also damage the engine.


A bridged or almost bridged spark plug, identified by a build-up between the electrodes caused by excessive carbon or oil build-up on the plug.

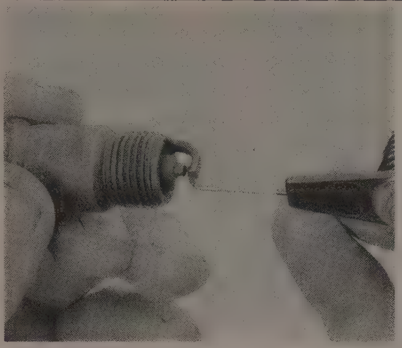
TCCA1P40

Fig. 91 Inspect the spark plug to determine engine running conditions



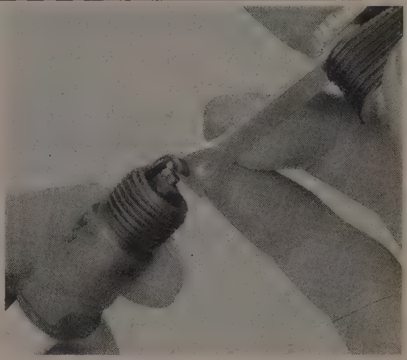
88471P23

Fig. 92 Remove the spark plug from the cylinder head for inspection



TCCS2903

Fig. 93 Check the spark plug gap with a feeler gauge



TCCS2904

Fig. 94 Adjusting the spark plug gap

When you're removing spark plugs, you should work on one at a time. Don't start by removing the plug wires all at once, because unless you number them, they may become mixed up. Take a minute before you begin and number the wires with tape. The best location for numbering is near where the wires come out of the cap.

1. Twist the spark plug boot to remove the boot and wire from the plug. Do not pull on the wire itself, as this will ruin the wire.
2. If possible, use a brush to clean the area around the spark plug. Make sure all the dirt is removed so that none will enter the cylinder after the plug is removed.
3. Remove the spark plug using the proper size socket: either a ⅝ in. (16mm) or 13⁄16 in. (21mm) size socket depending on the engine. Fully seat the socket straight on the plug to avoid breakage or rounding off of the hexagonal wrenching portion, then turn the socket counterclockwise.
4. Once the plug is out, check it against the plugs shown in the spark plug condition chart to determine whether the plug is good or not. (This is crucial since plug readings are vital signs of engine condition.) A plug that is in good condition may be filed and re-used.
5. Use a round wire feeler gauge to check the plug gap. The correct size gauge should pass through the electrode gap with a slight drag. If the gap is incorrect, use the electrode bending tool on the end of the gauge to adjust the gap. When adjusting the gap, always bend the side electrode; the center electrode is non-adjustable.

To install:

6. Squirt a drop of penetrating oil on the threads of the new plug and install it. Don't oil the threads too heavily. Turn the plug in clockwise by hand until it is snug.
7. When the plug is finger-tight, tighten it with a wrench. If you don't have a torque wrench, tighten the plug firmly until the crush gasket seats, but be careful not to strip the threads of the plug or cylinder head.

➡On some models equipped with electronic ignition, a small amount of silicone dielectric compound should be applied to the inside of the terminal boots whenever an ignition wire is disconnected from the spark plug or coil/distributor cap terminal.

8. Install the plug boot firmly over the plug. Proceed to the next plug.

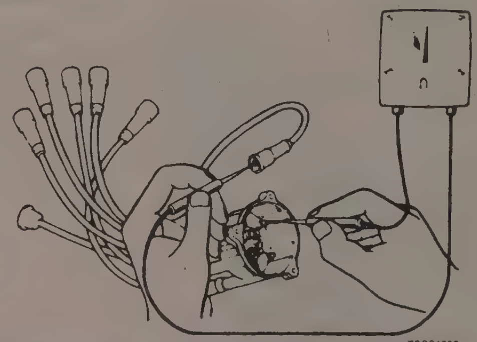
Spark Plug Wires

Spark plug wires transfer electrical current from the distributor to the individual spark plugs at each cylinder. The wires are of nonmetallic construction and have a built-in resistance. Most of the wires found on vehicles covered by this manual provide suppression of radio frequency emissions from the ignition system.

TESTING

➧ See Figure 95

Visually inspect the spark plug cables for burns, cuts, or breaks in the insulation. Check the spark plug boots and the nipples on the distributor cap and coil. Terminals should fit tightly. Loose connections provide poor conductivity and are an invitation for corrosion which will further diminish the strength of the spark. Replace any damaged wiring. If no physical damage is obvious, the wires can be checked with an ohmmeter for excessive resistance. Minimum spark plug resistance should be 250 ohms per inch (635 ohms per centimeter) and maximum resistance should be 1000 ohms per inch (2540 ohms per centimeter).



TCCS1008

Fig. 95 Checking plug wire resistance through the distributor cap with an ohmmeter

REMOVAL & INSTALLATION

1. Mark all the spark plug wires near the cap with their cylinder number for identification purposes.
2. Grasp and twist the spark plug boot until the boot comes free of the plug. Do not pull on the wire.
3. Repeat for the other spark plug wires.

To install:

4. When installing a new set of spark plug cables, replace the cables one at a time so there will be no mix-up. Start by replacing the longest cable first. Install the boot firmly over the spark plug. Route the wire exactly the same as the original. Insert the nipple firmly into the tower on the distributor cap.
5. Repeat the process for each cable.

Distributor Cap and Rotor

REMOVAL & INSTALLATION

➧ See Figures 96, 97, 98 and 99

1. Disconnect the negative battery cable.
2. Remove the distributor cap retaining screws and spark plug wires from the cap. If there is no wire retainer, be sure to tag all wires before disconnecting them from the distributor cap. Tagging wires will help preserve the proper firing order and greatly ease cap installation.

➡An alternate way to change caps is to situate the new cap next to the old (with the wires still attached) and simply swap the wires one-by-one from the old cap to the new cap in the exact same order.

3. On 2.5L engines, remove the distributor splash shield.
4. On V6 and V8 engines, unfasten the retaining clips and lift off the cap assembly.
5. Scribe or paint a mark on the edge of the distributor housing to indicate the position of the rotor. This will serve as a reference upon reinstallation.

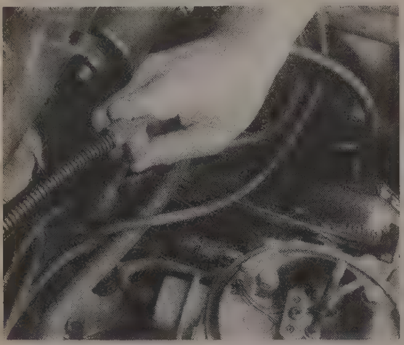


Fig. 96 Remove the coil wire from the center of the cap

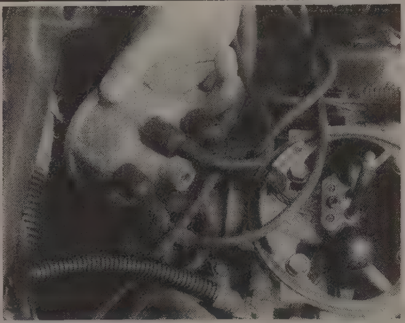


Fig. 97 Remove the old cap with its wires attached, then transfer the wires one-by-one

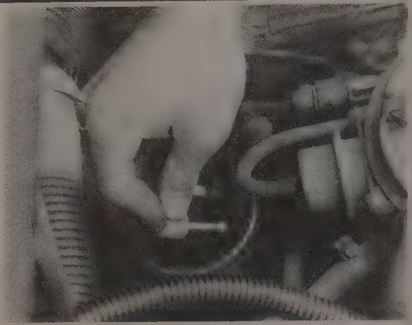


Fig. 98 White correction fluid makes an excellent quick paint for marking the rotor position

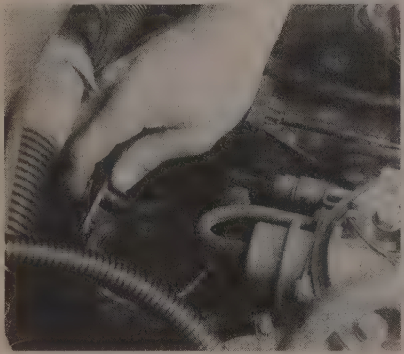


Fig. 99 Remove the rotor from the shaft

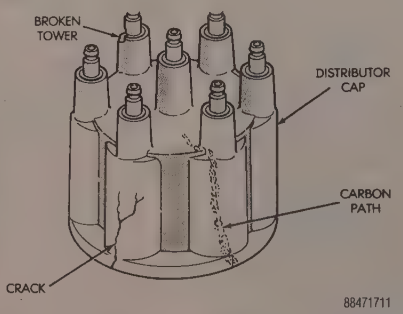


Fig. 100 Inspect the outside of the cap for any of the kinds of damage or wear that would warrant replacement

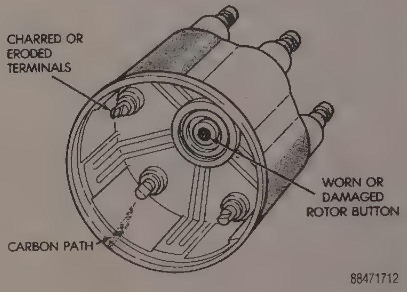


Fig. 101 Look carefully at the inside of the cap for signs of significant damage or wear

➡Although most rotors can only be installed in one direction, it is still wise to note the position of the rotor before removal to assure proper installation and ignition timing.

6. Remove the rotor attaching screw(s), if equipped, and note the position of the rotor, then remove the rotor from the distributor.

To install:

7. Install the rotor facing in the direction noted earlier, then if applicable, secure the rotor using the attaching screw(s).
8. Install the cap to the distributor assembly and secure using the housing retainers.
9. Install the spark plug wires and retainer to the cap. If no wire retainer is used, carefully connect the wires to the cap as tagged during removal.
10. Connect the negative battery cable.

INSPECTION

➧ See Figures 100 and 101

Remove the distributor cap and wipe it clean with a dry lint-free cloth. Visually inspect the cap for cracks, carbon paths, broken towers, or damaged rotor buttons. Also check for white deposits on the inside (caused by condensation entering through cracks). Replace any cap that has charred or eroded terminals. The inside flat surface of a terminal end (faces toward the rotor) will indicate some evidence of erosion from normal operation. Examine the terminal ends for evidence of mechanical interference with the rotor tip.

Ignition Timing

GENERAL INFORMATION

Ignition timing is the measurement, in degrees of crankshaft rotation, of the point at which the spark plugs fire in each of the cylinders. It is measured in degrees before or after Top Dead Center (TDC) of the compression stroke.

Ideally, the air/fuel mixture in the cylinder will be ignited by the spark plug just as the piston passes TDC of the compression stroke. If this happens, the piston will be beginning the power stroke just as the compressed and ignited air/fuel mixture starts to expand. The expansion of the air/fuel mixture then forces the piston down on the power stroke and turns the crankshaft.

Because it takes a fraction of a second for the spark plug to ignite the mixture in the cylinder, the spark plug must fire a little before the piston reaches TDC. Otherwise, the mixture will not be completely ignited as the piston passes TDC, and the full power of the explosion will not be used by the engine.

The timing measurement is given in degrees of crankshaft rotation before the piston reaches TDC (Before Top Dead Center or BTDC). If the setting for the ignition timing is 5° BTDC, each spark plug must fire 5° before each piston reaches TDC. This only holds true, however, when the engine is at idle speed.

As the engine speed increases, the pistons go faster. The spark plugs therefore have to ignite the fuel even sooner if it is to be completely ignited when the piston reaches TDC.

With the electronic ignition system used on these vehicles, the distributor has a means to advance the timing of the spark as the engine speed increases. In some cases, this is accomplished by centrifugal weights within the distributor and a vacuum diaphragm mounted on the side of the distributor. On distributors equipped with a vacuum diaphragm, it is necessary to disconnect the vacuum line when the ignition timing is being set.

If the ignition is set too far advanced (BTDC), the ignition and expansion of the fuel in the cylinder will occur too soon and tend to force the piston down while it is still traveling up. This causes engine ping. If the ignition spark is set too far retarded after TDC (ATDC), the piston will have already passed TDC and started on its way down when the fuel is ignited. This will cause the piston to be forced down for only a portion of its travel. This will result in poor engine performance and lack of power.

The timing is best checked with a timing light. This device is connected in series with the No. 1 spark plug. The current that fires the spark plug also causes the timing light to flash.

Setting the ignition timing is basically the same for all engines. It is best set with a timing light. The simple 12V test light should not be considered a substitute for a timing light. Test lights are generally useful, however, for finding approximate settings after the distributor has been removed and ignition timing disturbed.

Before setting the vacuum line (if equipped with vacuum advance) at the distributor should be disconnected and plugged (a golf tee is handy for doing this) and the timing set while at idle speed.

It is a good idea to paint the timing mark with day-glow or white paint to make it quickly and easily visible. Be sure that all wires, hands and arms are out of the way of the fan. Do not wear any loose clothing or a tie, when reaching anywhere near the fan.

➡On engines with electronic ignition, your timing light may or may not work, depending on the construction of the light. Consult the manufacturer of the light if in doubt.

INSPECTION & ADJUSTMENT

➡Base ignition timing is not adjustable on any 1992 or later V6, V8, or V10 engines. The distributors do not have centrifugal or vacuum advance. Instead, base ignition timing and advance on each of these engines is controlled by its Powertrain Control Module (PCM).

1989–91 V6 and V8 Engines; All 2.5L Engines

1. Insert the pickup probe of a magnetic timing light into the open receptacle next to the upper left bell housing bolt on the transmission on 2.5L engines, or into the tube near the timing marks on V6 and V8 engines. If a magnetic timing light is not available, use a conventional power timing light connected to the No. 1 spark plug wire.

⁂ CAUTION

DO NOT puncture spark plug wires, boots or nipples with test probes. Always use proper adapters. Puncturing the spark plug cables with probes will damage them. Breaking the rubber insulator may permit a secondary current arc which can ruin the coil.

2. Connect a tachometer to the engine and turn the selector to the proper cylinder position. Start the engine and run it until normal operating temperature is reached.
3. Disconnect the coolant temperature sensor connector. The instrument panel warning lights should come on. Engine rpm should be within emission label specifications. If not, refer to the tests in Section 4 for the throttle body minimum air flow check procedure before continuing.
4. Aim the power timing light at the timing marks or the hole in the bell housing, or read the magnetic timing unit.
5. Loosen the distributor hold-down bolt and adjust timing to emission label specifications.
6. Shut the engine off. Reconnect coolant temperature sensor. Disconnect and reconnect positive battery quick disconnect, or erase the fault codes as described in Section 4, then start the vehicle. The loss of power (check engine) lamp should be off.
7. Shut the engine **OFF**, then disconnect all test equipment.

Valve Lash

ADJUSTMENT

Gasoline Engines

No valve lash adjustment is necessary or possible on any of the Plymouth/Dodge-built engines covered by this manual. Hydraulic valve lifters automatically maintain zero clearance. After engine reassembly, these lifters adjust themselves as soon as engine oil pressure builds up.

Diesel Engine

➧ See Figures 102, 103 and 104

Valve adjustment is required on the diesel engine every 36,000 miles (57,971 km).

➡The timing pin is used in this procedure to locate Top Dead Center (TDC). It is found at the back of the gear housing and below the injection pump. Be sure to disengage the timing pin after locating TDC.

⁂ WARNING

Do not set the valve lash closer than specified in an attempt to quiet the lifters. This will only result in burned valves.

1. The engine must be cold for this adjustment (below 140°F/60°C).
2. Remove the valve cover.
3. Manually turn the engine and use the timing pin to locate Top Dead Center (TDC) for cylinder No. 1. Disengage the timing pin after locating TDC.
4. Perform the following two-step procedure to adjust the valves. Refer to the accompanying illustrations to determine which valves to adjust in each of the steps:
    a. Valve lash is measured between the rocker arm and the end of the valve. Check the lash by inserting a feeler gauge between the rocker arm and the valve. Adjust the clearance, if necessary. The clearance for the intake valves is 0.010 in. (0.254mm). The clearance for the exhaust valves is 0.20 in. (0.508mm). Adjust the lash by loosening the locknut on the rocker arm and turning the adjusting screw. After the adjustment is made, tighten the locknut to 18 ft. lbs. (24 Nm) and recheck the lash to be sure it did not change as the locknut was being tightened.
    b. Double-check that the timing pin is disengaged, then mark the pulley and turn the engine crankshaft 360° in the normal direction of rotation (clockwise). Check and adjust the clearance of the indicated valves following the same specifications as in Step 4a.
5. Install the rocker cover with a new gasket, then attach the fuel line to the injector. Start the engine and check for leaks.

Minimum Idle Speed Adjustment

GASOLINE ENGINES

Unlike carbureted vehicles, the fuel injected engines covered in this manual do not require idle speed adjustment checks as a part of a regular tune-up. In

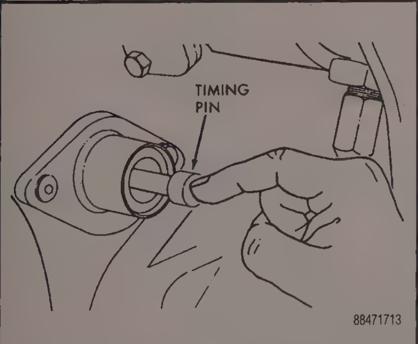


Fig. 102 Use the timing pin to locate TDC for diesel engines

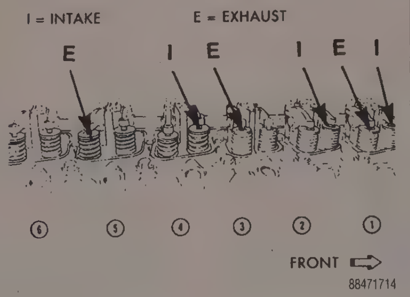


Fig. 103 Adjust the intake and exhaust valves shown in this first phase of the diesel valve adjustment procedure

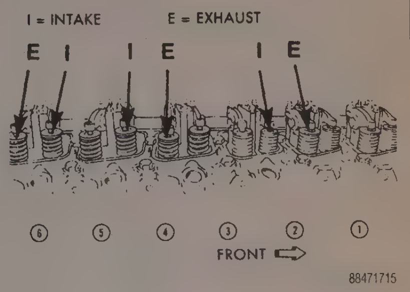


Fig. 104 Adjust the intake and exhaust valves shown in this second stage of the diesel valve adjustment

fact normal idle speed is NOT adjustable and should not be attempted. Base idle speed is controlled by the engine controller (computer).

➡This adjustment is the minimum idle speed with the Automatic Idle Speed (AIS) closed.

1. Before adjusting the idle on an electronic fuel injected vehicle, the following items must be checked (and corrected, if necessary):
   - AIS motor operation
   - Engine vacuum and/or EGR leaks
   - Engine timing
   - Coolant temperature sensor operation
2. Connect a tachometer and timing light to the engine, according to the manufacturer's instructions.
3. Close the AIS by using ATM tester C–4805 or equivalent, and ATM test code #03.
4. Connect a jumper to the radiator fan, so that it will run continuously.
5. Start and run the engine for 3 minutes to allow the idle speed to stabilize.
6. Check engine rpm and compare the result with the specifications listed on the underhood emission control sticker.
7. If idle rpm is not within specifications, use tool C–4804 or equivalent to turn the idle speed adjusting screw to obtain 790–810 rpm. If the underhood emission sticker specifications are different, use those values for adjustment.

➡If idle will not adjust down check for binding linkage, speed control servo cable adjustment or throttle shaft binding.

8. Turn the engine **OFF**, then disconnect the tachometer, reattach the AIS wire, and remove the jumper wire from the fan motor.

DIESEL ENGINE

The low speed idle is the only adjustment which can be made to the injection pump. All other injection pump service requires a qualified diesel engine technician.

Use an optical diesel engine tachometer to read engine rpm. If necessary, adjust low idle speed at the low idle speed screw. If the vehicle is equipped with an automatic transmission, with the A/C on, set the low speed idle to 700 rpm. If equipped with a manual transmission, with the A/C on, set the idle to 750 rpm. A special Cummins tool No. 3823750 is required to loosen the idle speed locknut for adjustment.

GASOLINE ENGINE TUNE-UP SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Spark Plugs Gap (In.)	Ignition Timing (deg.)		Fuel Pump (psi)	Idle Speed (rpm)		Valve Clearance	
				MT	AT		MT	AT	In.	Ex.
1989	K	2.5 (2507)	0.035	12B	12B	13.5-15.5	850	850	HYD	HYD
	X	3.9 (3916)	0.035	10B	10B	13-16	750	750	HYD	HYD
	Y	5.2 (5211)	0.035	10B	10B	13-16	700	700	HYD	HYD
	W	5.9 (5899)	0.035	10B	10B	5-7	800	800	HYD	HYD
	Z	5.9 (5899)	0.035	10B	10B	13.5-15.5	700	700	HYD	HYD
1990	K	2.5 (2507)	0.035-0.043	12B	12B	13.5-15.5	850	850	HYD	HYD
	X	3.9 (3916)	0.035	10B	10B	13-16	750	750	HYD	HYD
	Y	5.2 (5211)	0.035	10B	10B	13-16	700	700	HYD	HYD
	5	5.9 (5899)	0.035	10B	10B	13.5-15.5	700	700	HYD	HYD
	Z	5.9 (5899)	0.035	10B	10B	13.5-15.5	700	700	HYD	HYD
1991	K	2.5 (2507)	0.035-0.043	12B	12B	13.5-15.5	850	850	HYD	HYD
	X	3.9 (3916)	0.035	10B	10B	13-16	750	750	HYD	HYD
	Y	5.2 (5211)	0.035	10B	10B	13-16	700	700	HYD	HYD
	5	5.9 (5899)	0.035	10B	10B	13.5-15.5	700	700	HYD	HYD
	Z	5.9 (5899)	0.035	10B	10B	13.5-15.5	700	700	HYD	HYD
1992	K	2.5 (2507)	0.035	12B	12B	37-41	850	850	HYD	HYD
	X	3.9 (3916)	0.035	[1]	[1]	37-41	750	750	HYD	HYD
	Y	5.2 (5211)	0.035	[1]	[1]	37-41	700	700	HYD	HYD
	5	5.9 (5899)	0.035	10B	10B	13.5-15.5	700	700	HYD	HYD
	Z	5.9 (5899)	0.035	10B	10B	13.5-15.5	700	700	HYD	HYD
1993	K	2.5 (2507)	0.035	12B	12B	37-41	850	850	HYD	HYD
	X	3.9 (3916)	0.035	[1]	[1]	37-41	750	750	HYD	HYD
	Y	5.2 (5211)	0.035	[1]	[1]	37-41	700	700	HYD	HYD
	5	5.9 (5899)	0.035	[1]	[1]	35-45	700	700	HYD	HYD
	Z	5.9 (5899)	0.035	[1]	[1]	35-45	700	700	HYD	HYD
1994	K	2.5 (2507)	0.035	12B	12B	37-41	[2]	[2]	HYD	HYD
	X	3.9 (3916)	0.035	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	Y	5.2 (5211)	0.035	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	5	5.9 (5899)	0.035	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	Z	5.9 (5899)	0.035	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	W	8.0 (7997)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
1995	G	2.5 (2507)	0.035	[3]	[3]	14.5	[2]	[2]	HYD	HYD
	X	3.9 (3916)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	Y	5.2 (5211)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	5	5.9 (5899)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	Z	5.9 (5899)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	W	8.0 (7997)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
1996	G	2.5 (2507)	0.035	[3]	[3]	14.5	[2]	[2]	HYD	HYD
	X	3.9 (3916)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	Y	5.2 (5211)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	5	5.9 (5899)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	Z	5.9 (5899)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD
	W	8.0 (7997)	0.030	[1]	[1]	35-45	[2]	[2]	HYD	HYD

NOTE: The Vehicle Emission Control Information (VECI) label often reflects specification changes made during production. The label figures must be used if they differ from this chart

B - Before Top Dead Center

HYD - Hydraulic

[1] Ignition timing is not adjustable. Base timing set at TDC during assembly

[2] Refer to the VECI label for the correct timing specification

[3] Refer to the VECI label for correct timing specification with a range of plus or minus 2

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DIESEL ENGINE TUNE-UP SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement cu. in. (cc)	Valve Clearance		Intake Valve Opens (deg.)	Injection Pump Setting (deg.)	Injection Nozzle Pressure (psi)		Idle Speed (rpm)	Cranking Compression Pressure (psi)
			Intake (in.)	Exhaust (in.)			New	Used		
1989	8	5.9 (5882)	0.010	0.020	NA	[1]	3550	NA	[2]	NA
1990	8	5.9 (5882)	0.010	0.020	NA	[1]	3550	NA	[2]	NA
1991	8	5.9 (5882)	0.010	0.020	NA	[1]	3550	NA	[2]	NA
1992	8	5.9 (5882)	0.010	0.020	NA	[1]	3550	NA	[2]	NA
1993	8	5.9 (5882)	0.010	0.020	NA	[1]	3550	NA	[2]	NA
1994	C	5.9 (5882)	0.010	0.020	NA	[1]	3822	NA	[2]	NA
1995	C	5.9 (5882)	0.010	0.020	NA	[1]	3822	NA	[3]	NA
1996	C	5.9 (5882)	0.010	0.020	NA	[1]	3822	NA	[3]	NA

NOTE: The Vehicle Emission Control Information (VECI) label often reflects specification changes made during production.
The label figures must be used if they differ from those in this chart
NA - Not Available
Align marks on pump flange and gear housing
Automatic transmission with A/C - 700 rpm; Manual transmission with A/C - 750 rpm
Automatic transmission with A/C· 750-800 rpm, Manual transmission with A/C - 750 rpm

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Air Conditioning System

SYSTEM SERVICE & REPAIR

➡It is recommended that the A/C system be serviced by an EPA Section 609 certified automotive technician utilizing a refrigerant recovery/recycling machine.

The do-it-yourselfer should not service his/her own vehicle's A/C system for many reasons, including legal concerns, personal injury, environmental damage and cost.

According to the U.S. Clean Air Act, it is a federal crime to service or repair (involving the refrigerant) a Motor Vehicle Air Conditioning (MVAC) system for money without being EPA certified. It is also illegal to vent R-12 and R-134a refrigerants into the atmosphere. State and/or local laws may be more strict than the federal regulations, so be sure to check with your state and/or local authorities for further information.

➡Federal law dictates that a fine of up to $25,000 may be levied on people convicted of venting refrigerant into the atmosphere.

When servicing an A/C system you run the risk of handling or coming in contact with refrigerant, which may result in skin or eye irritation or frostbite. Although low in toxicity (due to chemical stability), inhalation of concentrated refrigerant fumes is dangerous and can result in death; cases of fatal cardiac arrhythmia have been reported in people accidentally subjected to high levels of refrigerant. Some early symptoms include loss of concentration and drowsiness.

➡Generally, the limit for exposure is lower for R-134a than it is for R-12. Exceptional care must be practiced when handling R-134a.

Also, some refrigerants can decompose at high temperatures (near gas heaters or open flame), which may result in hydrofluoric acid, hydrochloric acid and phosgene (a fatal nerve gas).

It is usually more economically feasible to have a certified MVAC automotive technician perform A/C system service on your vehicle.

R-12 Refrigerant Conversion

If your vehicle still uses R-12 refrigerant, one way to save A/C system costs down the road is to investigate the possibility of having your system converted to R-134a. The older R-12 systems can be easily converted to R-134a refrigerant by a certified automotive technician by installing a few new components and changing the system oil.

The cost of R-12 is steadily rising and will continue to increase, because it is no longer imported or manufactured in the United States. Therefore, it is often possible to have an R-12 system converted to R-134a and recharged for less than it would cost to just charge the system with R-12.

If you are interested in having your system converted, contact local automotive service stations for more details and information.

PREVENTIVE MAINTENANCE

Although the A/C system should not be serviced by the do-it-yourselfer, preventive maintenance should be practiced to help maintain the efficiency of the vehicle's A/C system. Be sure to perform the following:

- The easiest and most important preventive maintenance for your A/C system is to be sure that it is used on a regular basis. Running the system for five minutes each month (no matter what the season) will help ensure that the seals and all internal components remain lubricated.

➡Some vehicles automatically operate the A/C system compressor whenever the windshield defroster is activated. Therefore, the A/C system would not need to be operated each month if the defroster was used.

- In order to prevent heater core freeze-up during A/C operation, it is necessary to maintain proper antifreeze protection. Be sure to properly maintain the engine cooling system.
- Any obstruction of or damage to the condenser configuration will restrict air flow which is essential to its efficient operation. Keep this unit clean and in proper physical shape.

➡Bug screens which are mounted in front of the condenser (unless they are original equipment) are regarded as obstructions.

- The condensation drain tube expels any water which accumulates on the bottom of the evaporator housing into the engine compartment. If this tube is obstructed, the air conditioning performance can be restricted and condensation buildup can spill over onto the vehicle's floor.

SYSTEM INSPECTION

Although the A/C system should not be serviced by the do-it-yourselfer, system inspections should be performed to help maintain the efficiency of the vehicle's A/C system. Be sure to perform the following:

The easiest and often most important check for the air conditioning system consists of a visual inspection of the system components. Visually inspect the system for refrigerant leaks, damaged compressor clutch, abnormal compressor drive belt tension and/or condition, plugged evaporator drain tube, blocked condenser fins, disconnected or broken wires, blown fuses, corroded connections and poor insulation.

A refrigerant leak will usually appear as an oily residue at the leakage point in the system. The oily residue soon picks up dust or dirt particles from the surrounding air and appears greasy. Through time, this will build up and appear to be a heavy dirt impregnated grease.

For a thorough visual and operational inspection, check the following:

- Check the surface of the radiator and condenser for dirt, leaves or other material which might block air flow.
- Check for kinks in hoses and lines. Check the system for leaks.
- Make sure the drive belt is properly tensioned. During operation, make sure the belt is free of noise or slippage.

- Make sure the blower motor operates at all appropriate positions, then check for distribution of the air from all outlets.

➡Remember that in high humidity, air discharged from the vents may not feel as cold as expected, even if the system is working properly. This is because moisture in humid air retains heat more effectively than dry air, thereby making humid air more difficult to cool.

Windshield Wipers

ELEMENT (REFILL) CARE & REPLACEMENT

▶ **See Figures 105, 106 and 107**

For maximum effectiveness and longest element life, the windshield and wiper blades should be kept clean. Dirt, tree sap, road tar and so on will cause streaking, smearing and blade deterioration if left on the glass. It is advisable to wash the windshield carefully with a commercial glass cleaner at least once a month. Wipe off the rubber blades with the wet rag afterwards. Do not attempt to move wipers across the windshield by hand; damage to the motor and drive mechanism will result.

To inspect and/or replace the wiper blade elements, place the wiper switch in the **LOW** speed position and the ignition switch in the **ACC** position. When the wiper blades are approximately vertical on the windshield, turn the ignition switch to **OFF**.

Examine the wiper blade elements. If they are found to be cracked, broken or torn, they should be replaced immediately. Replacement intervals will vary with usage, although ozone deterioration usually limits element life to about one year. If the wiper pattern is smeared or streaked, or if the blade chatters across the glass, the elements should be replaced. It is easiest and most sensible to replace the elements in pairs.

If your vehicle is equipped with aftermarket blades, there are several different types of refills and your vehicle might have any kind. Aftermarket blades and arms rarely use the exact same type blade or refill as the original equipment.

Regardless of the type of refill used, be sure to follow the part manufacturer's instructions closely. Make sure that all of the frame jaws are engaged as the refill is pushed into place and locked. If the metal blade holder and frame are allowed to touch the glass during wiper operation, the glass will be scratched.

Tires and Wheels

Common sense and good driving habits will afford maximum tire life. Make sure that you don't overload the vehicle or run with incorrect pressure in the tires. Either of these will increase tread wear. Fast starts, sudden stops and sharp cornering are hard on tires and will shorten their useful life span.

➡For optimum tire life, keep the tires properly inflated, rotate them often and have the wheel alignment checked periodically.

Inspect your tires frequently. Be especially careful to watch for bubbles in the tread or sidewall, deep cuts or underinflation. Replace any tires with bubbles in the sidewall. If cuts are so deep that they penetrate to the cords, discard the tire. Any cut in the sidewall of a radial tire renders it unsafe. Also look for uneven tread wear patterns that may indicate the front end is out of alignment or that the tires are out of balance.

TIRE ROTATION

▶ **See Figure 108**

Tires must be rotated periodically to equalize wear patterns that vary with a tire's position on the vehicle. Tires will also wear in an uneven way as the front steering/suspension system wears to the point where the alignment should be reset.

Rotating the tires will ensure maximum life for the tires as a set, so you will not have to discard a tire early due to wear on only part of the tread. Regular rotation is required to equalize wear.

When rotating "unidirectional tires," make sure that they always roll in the same direction. This means that a tire used on the left side of the vehicle must not be switched to the right side and vice-versa. Such tires should only be rotated front-to-rear or rear-to-front, while always remaining on the same side of the vehicle. These tires are marked on the sidewall as to the direction of rotation; observe the marks when reinstalling the tire(s).

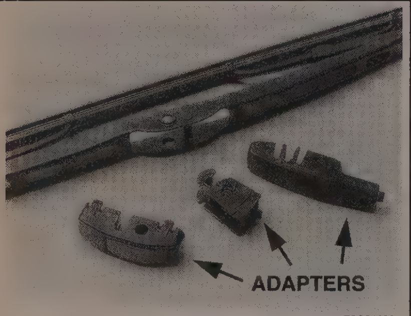


Fig. 105 Most aftermarket blades are available with multiple adapters to fit different vehicles

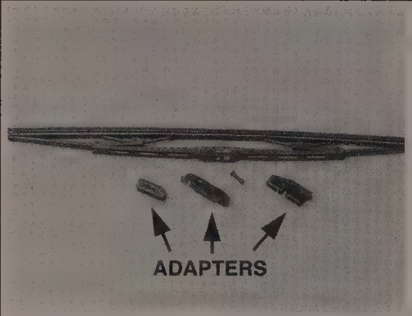


Fig. 106 Choose a blade which will fit your vehicle, and that will be readily available next time you need blades

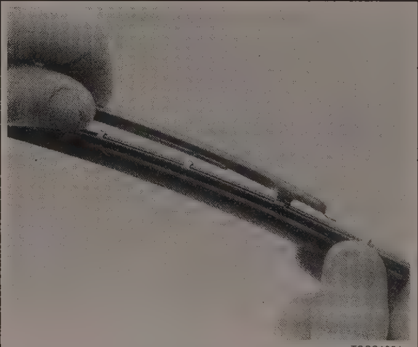


Fig. 107 When installed, be certain the blade is fully inserted into the backing

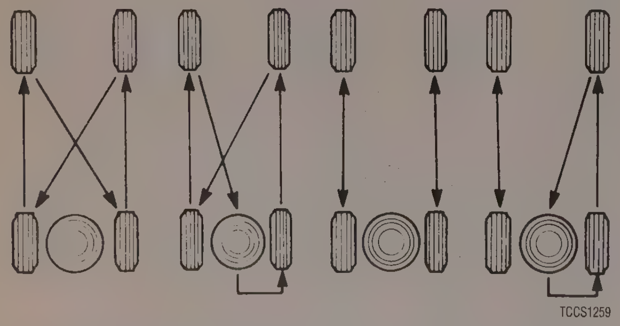


Fig. 108 Common tire rotation patterns for 4 and 5-wheel rotations

Some styled or "mag" wheels may have different offsets front to rear. In these cases, the rear wheels must not be used up front and vice-versa. Furthermore, if these wheels are equipped with unidirectional tires, they cannot be rotated unless the tire is remounted for the proper direction of rotation.

➡The compact or space-saver spare is strictly for emergency use. It must never be included in the tire rotation or placed on the vehicle for everyday use.

TIRE DESIGN

▶ **See Figure 109**

For maximum satisfaction, tires should be used in sets of four. Mixing of different brands or types (radial, bias-belted, fiberglass belted) should be avoided. In most cases, the vehicle manufacturer has designated a type of tire on which the vehicle will perform best. Your first choice when replacing tires should be to use the same type of tire that the manufacturer recommends.

When radial tires are used, tire sizes and wheel diameters should be selected to maintain ground clearance and tire load capacity equivalent to the original specified tire. Radial tires should always be used in sets of four.

**** CAUTION**

Radial tires should never be used on only the front axle.

When selecting tires, pay attention to the original size as marked on the tire. Most tires are described using an industry size code sometimes referred to as P-Metric. This allows the exact identification of the tire specifications, regardless of the manufacturer. If selecting a different tire size or brand, remember to check the installed tire for any sign of interference with the body or suspension while the vehicle is stopping, turning sharply or heavily loaded.

Snow Tires

Good radial tires can produce a big advantage in slippery weather, but in snow, a street radial tire does not have sufficient tread to provide traction and control. The small grooves of a street tire quickly pack with snow and the tire behaves like a billiard ball on a marble floor. The more open, chunky tread of a snow tire will self-clean as the tire turns, providing much better grip on snowy surfaces.

To satisfy municipalities requiring snow tires during weather emergencies, most snow tires carry either an M + S designation after the tire size stamped on the sidewall, or the designation "all-season." In general, no change in tire size is necessary when buying snow tires.

Most manufacturers strongly recommend the use of 4 snow tires on their vehicles for reasons of stability. If snow tires are fitted only to the drive wheels, the opposite end of the vehicle may become very unstable when braking or turning on slippery surfaces. This instability can lead to unpleasant endings if the driver can't counteract the slide in time.

Note that snow tires, whether 2 or 4, will affect vehicle handling in all non-snow situations. The stiffer, heavier snow tires will noticeably change the turning and braking characteristics of the vehicle. Once the snow tires are installed, you must re-learn the behavior of the vehicle and drive accordingly.

➡Consider buying extra wheels on which to mount the snow tires. Once done, the "snow wheels" can be installed and removed as needed. This eliminates the potential damage to tires or wheels from seasonal removal and installation. Even if your vehicle has styled wheels, see if inexpensive steel wheels are available. Although the look of the vehicle will change, the expensive wheels will be protected from salt, curb hits and pothole damage.

TIRE STORAGE

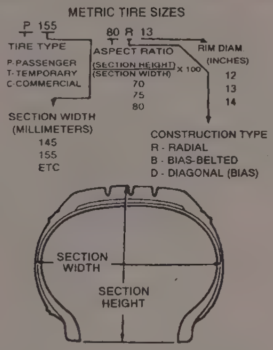
If they are mounted on wheels, store the tires at proper inflation pressure. All tires should be kept in a cool, dry place. If they are stored in the garage or basement, do not let them stand on a concrete floor; set them on strips of wood, a mat or a large stack of newspaper. Keeping them away from direct moisture is of paramount importance. Tires should not be stored upright, but in a flat position.

INFLATION & INSPECTION

➧ See Figures 110 thru 115

The importance of proper tire inflation cannot be overemphasized. A tire employs air as part of its structure. It is designed around the supporting strength of the air at a specified pressure. For this reason, improper inflation drastically reduces the tire's ability to perform as intended. A tire will lose some air in day-to-day use; having to add a few pounds of air periodically is not necessarily a sign of a leaking tire.

Two items should be a permanent fixture in every glove compartment: an accurate tire pressure gauge and a tread depth gauge. Check the tire pressure (including the spare) regularly with a pocket type gauge. Too often, the gauge on the end of the air hose at your corner garage is not accurate because it suffers too much abuse. Always check tire pressure when the tires are cold, as pressure increases with temperature. If you must move the vehicle to check the



TCCS1261

Fig. 109 P-Metric tire coding

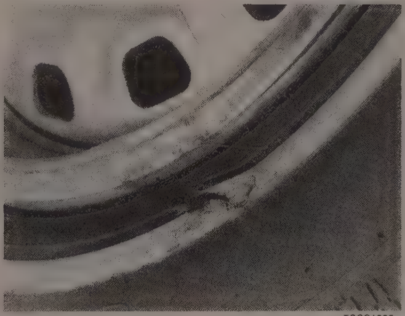


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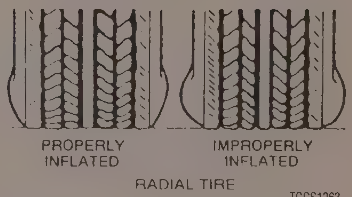
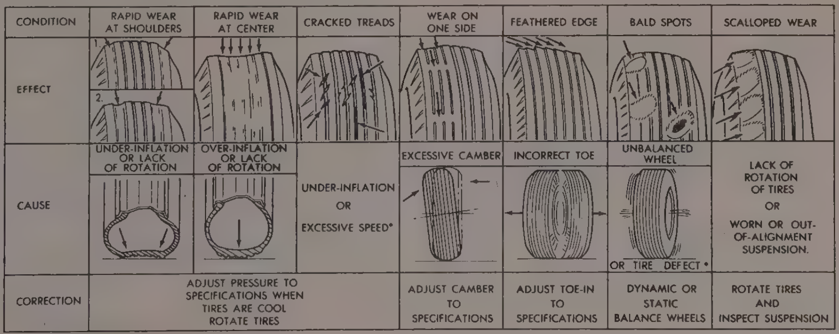
Fig. 110 Tires with deep cuts, or cuts which bulge, should be replaced immediately



TCCS1263

Fig. 111 Radial tires have a characteristic sidewall bulge; don't try to measure pressure by looking at the tire. Use a quality air pressure gauge



CONDITION	RAPID WEAR AT SHOULDERS	RAPID WEAR AT CENTER	CRACKED TREADS	WEAR ON ONE SIDE	FEATHERED EDGE	BALD SPOTS	SCALLOPED WEAR
EFFECT	1. 2.						
CAUSE	UNDER-INFLATION OR LACK OF ROTATION	OVER-INFLATION OR LACK OF ROTATION	UNDER-INFLATION OR EXCESSIVE SPEED*	EXCESSIVE CAMBER	INCORRECT TOE	UNBALANCED WHEEL OR TIRE DEFECT*	LACK OF ROTATION OF TIRES OR WORN OR OUT-OF-ALIGNMENT SUSPENSION.
CORRECTION	ADJUST PRESSURE TO SPECIFICATIONS WHEN TIRES ARE COOL ROTATE TIRES			ADJUST CAMBER TO SPECIFICATIONS	ADJUST TOE-IN TO SPECIFICATIONS	DYNAMIC OR STATIC BALANCE WHEELS	ROTATE TIRES AND INSPECT SUSPENSION

*HAVE TIRE INSPECTED FOR FURTHER USE.

TCCS1267

Fig. 112 Common tire wear patterns and causes

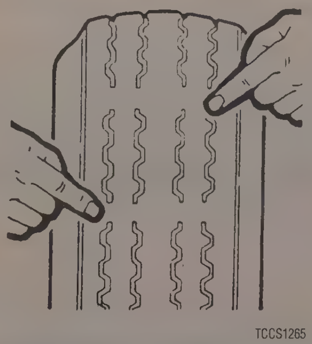


Fig. 113 Tread wear indicators will appear when the tire is worn

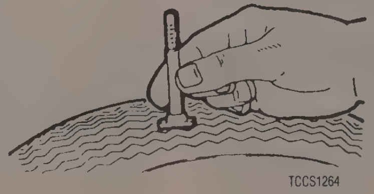


Fig. 114 Accurate tread depth indicators are inexpensive and handy

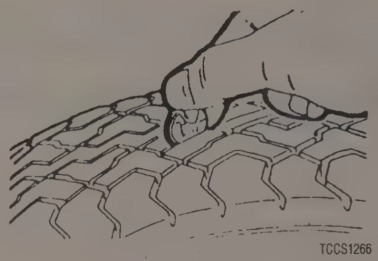


Fig. 115 A penny works well for a quick check of tread depth

tire inflation, do not drive more than a mile before checking. A cold tire is generally one that has not been driven for more than three hours.

A plate or sticker is normally provided somewhere in the vehicle (door post, hood, tailgate or trunk lid) which shows the proper pressure for the tires. Never counteract excessive pressure build-up by bleeding off air pressure (letting some air out). This will cause the tire to run hotter and wear quicker.

✻✻ CAUTION

Never exceed the maximum tire pressure embossed on the tire! This is the pressure to be used when the tire is at maximum loading, but it is rarely the correct pressure for everyday driving. Consult the owner's manual or the tire pressure sticker for the correct tire pressure.

Once you've maintained the correct tire pressures for several weeks, you'll be familiar with the vehicle's braking and handling personality. Slight adjustments in tire pressures can fine-tune these characteristics, but never change the cold pressure specification by more than 2 psi. A slightly softer tire pressure will give a softer ride but also yield lower fuel mileage. A slightly harder tire will give crisper dry road handling but can cause skidding on wet surfaces. Unless you're fully attuned to the vehicle, stick to the recommended inflation pressures.

All automotive tires have built-in tread wear indicator bars that show up as ½ in. (13mm) wide smooth bands across the tire when 1⁄16 in. (1.5mm) of tread remains. The appearance of tread wear indicators means that the tires should be replaced. In fact, many states have laws prohibiting the use of tires with less than this amount of tread.

You can check your own tread depth with an inexpensive gauge or by using a Lincoln head penny. Slip the Lincoln penny (with Lincoln's head upside-down) into several tread grooves. If you can see the top of Lincoln's head in 2 adjacent grooves, the tire has less than 1⁄16 in. (1.5mm) tread left and should be replaced. You can measure snow tires in the same manner by using the "tails" side of the Lincoln penny. If you can see the top of the Lincoln memorial, it's time to replace the snow tire(s).

Service Reminder Indicator (SRI) Lamp

➧ See Figures 116 and 117

The Service Reminder Indicator (SRI) lamp is used with 5.9L V8 heavy duty and 8.0L gas powered engines only. It is not used with diesel engines. The lamp is found on the instrument panel and reads "MAINT REQ'D."

The SRI system is a part of the engine controller computer. It records vehicle mileage and stores it in memory. The engine controller checks for certain mileage intervals. When they are reached, the SRI lamp is illuminated on the instrument panel.

When the vehicle's SRI lamp comes on, check the vehicle's odometer and check the maintenance interval charts in this manual.

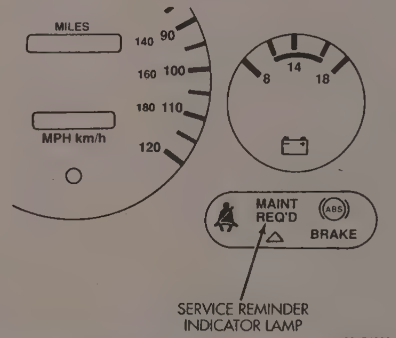


Fig. 116 The SRI indicator lamp is used on heavy duty 5.9L V8 and V10 engines

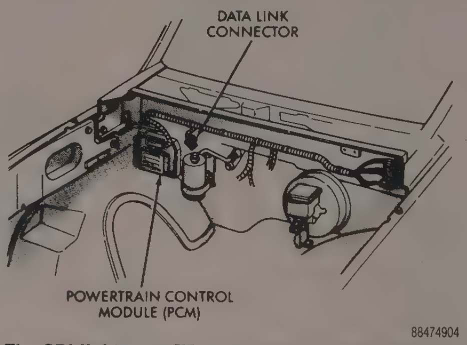


Fig. 117 The SRI light must be reset using a DRBII scan tool, or equivalent, hooked to the data link connector

➡If you only reset the light and fail to replace the necessary parts or perform required maintenance, you may be acting in violation of federal law. Only after the required work is performed should the light be reset.

RESETTING

The SRI lamp may only be reset with the use of a DRBII scan tool, or equivalent. If this is not available, you will have to take the vehicle to a properly equipped shop for them to reset the lamp.

1. Connect the DRBII scan tool, or equivalent to the data link connector in the engine compartment.
2. Follow the manufacturer's directions for resetting the SRI-lamp.

FLUIDS AND LUBRICANTS

Fluid Disposal

Used fluids such as engine oil, transmission fluid, antifreeze and brake fluid are hazardous wastes which must be disposed of properly. Before draining any fluids, consult with local authorities; in many cases, waste oil, coolant, etc. are accepted as part of recycling programs. A number of service stations and auto parts stores are also accepting waste fluids for recycling.

Be sure of the recycling center's policies before draining the fluids, as many will not accept mixed fluids such as oil and antifreeze.

Fuel and Engine Oil Recommendations

➧ See Figure 118

GASOLINE ENGINES

➧ See Figures 119 and 120

All late model trucks are designed to run on unleaded gasoline. Any vehicle originally equipped with a catalytic converter MUST use unleaded gasoline.

The recommended oil viscosities for sustained temperatures ranging from below −10°F (−23°C) to above 100°F (38°C) are listed in this section. They are broken down into multi-viscosities and single viscosities. Multi-viscosity oils are recommended because of their wider range of acceptable temperatures and driving conditions.

When adding oil to the crankcase or when changing the oil and filter, it is important that oil of an equal quality to original equipment be used in your truck. The use of inferior oils may void the warranty, damage your engine, or both.

The Society of Automotive Engineers (SAE) grade number indicates the oil's viscosity (its ability to lubricate at a given temperature). The lower the SAE number, the lighter the oil; the lower the viscosity, the easier it is to crank the engine in cold weather but the less the oil will lubricate and protect the engine in high temperatures. This number is marked on every oil container.

Oil viscosities should be chosen from those oils recommended for the lowest anticipated temperatures during the oil change interval. Due to the need for an oil that embodies both good lubrication at high temperatures and easy cranking in cold weather, multigrade oils have been developed. Basically, a multigrade oil is thinner at low temperatures and thicker at high temperatures. For example, a 10W–40 oil (the W stands for winter) exhibits the characteristics of a 10 weight (SAE 10) oil when the truck is first started and the oil is cold. Its lighter weight allows it to travel to the lubricating surfaces quicker and offer less resistance to starter motor cranking than, say, a straight 30 weight (SAE 30) oil. But after the engine reaches operating temperature, the 10W–40 oil begins acting like straight 40 weight (SAE 40) oil, its heavier weight providing greater lubrication with less chance of foaming than a straight 30 weight oil.

The American Petroleum Institute (API) designations, also found on the oil container, indicates the classification of engine oil used under certain given operating conditions. Only oils designated for use Service SF (or a later superceding designation) heavy duty detergent should be used in your truck. Oils of the SF type perform may functions inside the engine besides their basic lubrication. Through a balanced system of metallic detergents and polymeric dispersants, the oil prevents high and low temperature deposits, while keeping sludge and dirt particles in suspension. Acids, particularly sulfuric acid, as well as other by products of engine combustion, are neutralized by the oil. If these acids are allowed to concentrate, they can cause corrosion and rapid wear of the internal engine parts.

✲✲ WARNING

Non-detergent motor oils or straight mineral oils should not be used in your Plymouth/Dodge gasoline engine.

DIESEL ENGINES

➧ See Figure 121

Diesel engines require different engine oil from those used in gasoline engines. Besides providing the protection that gasoline engine oil does, diesel oil must also deal with increased engine heat and the diesel blow-by gases, which create sulfuric acid, a highly corrosive substance.

Under the American Petroleum Institute (API) classifications, gasoline engine oil codes begin with an **S**, and diesel engine oil codes begin with a **C**. This first letter designation is followed by a second letter code which explains what type of service (heavy, moderate, light) the oil is meant for. For example, the label of a typical oil bottle may well include: API SERVICES SF, CD. This means the oil is a superior, heavy duty engine oil and can be used in a diesel engine.

Many diesel manufacturers recommend an oil with both gasoline and diesel engine API classifications.

➡Chrysler Corp. specifies the use of an engine oil conforming to API service categories of BOTH SG and CD (or the latest superceding codes). DO NOT use oils labeled as only SG or only CD, as they could cause engine damage.

Fuel makers commonly produce two grades of diesel fuel for use in automotive diesel engines No. 1 and No. 2. Generally speaking, No. 2 fuel is recommended over No. 1 for driving in temperatures above 20°F (7°C). In fact, in many areas, No. 2 diesel is the only fuel available. By comparison, No. 2 diesel fuel is less volatile than No. 1 fuel, and gives better fuel economy. Also, No. 2 fuel is a better injection pump lubricant.

The cetane number of a diesel fuel refers to the ease with which a diesel fuel ignites. High cetane numbers mean that the fuel will ignite with relative ease or that it ignites well at low temperatures. Naturally, the lower the cetane number, the higher the temperature must be to ignite the fuel. Most commercial fuels have cetane numbers that range from 35–65. No. 1 diesel fuel generally has a higher cetane rating than No. 2 fuel.

As the temperature goes down, diesel fuel tends to thicken. Diesel fuel contains paraffins (wax) and at low ambient temperatures, wax crystals begin forming in the fuel. The temperature at which this occurs is known as the cloud point. The cloud point for diesel fuel varies due to its composition and that information should be available from your fuel supplier or gas station. A typical cloud point temperature is 10°F (−12°C). This is an important piece of informa-

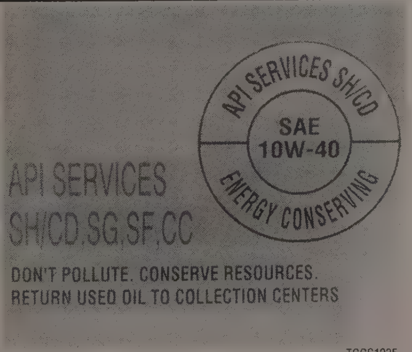

API SERVICES SH/CD
SAE 10W-40
ENERGY CONSERVING
API SERVICES SH/CD,SG,SF,CC
DON'T POLLUTE. CONSERVE RESOURCES.
RETURN USED OIL TO COLLECTION CENTERS

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Fig. 118 Look for the API oil identification label when choosing your engine oil

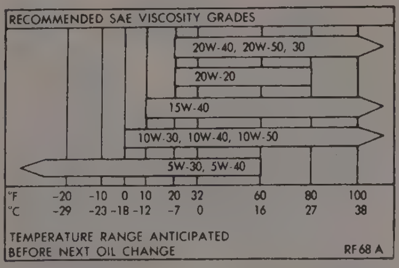

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Fig. 119 Gasoline engine oil viscosity chart

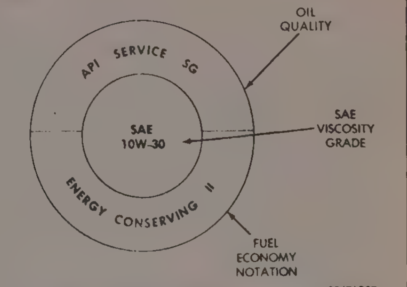

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Fig. 120 Standard markings found on engine oil containers that designate API service classifications, and other pertinent information

tion as is extremely cold weather, diesel fuel can stop flowing altogether. This can result in no start condition or poor engine performance.

Depending on local climate, most fuel manufacturers make winterized No. 2 fuel available seasonally. The manufacturers often winterize No. 2 diesel fuel using various fuel additives and blends (No. 1 diesel fuel, kerosene, etc.) to lower its winter time viscosity. Generally speaking, though, No. 1 diesel fuel is more satisfactory in extremely cold weather.

➡No. 1 and No. 2 diesel fuels will mix and burn with no ill effects, although the engine manufacturer will undoubtedly recommend one or the other. Consult the owner's manual for information.

Many automobile manufacturers publish pamphlets giving the locations of diesel fuel stations nationwide. Contact a local dealer for information.

When planning a trip with a diesel powered vehicle, take into account the temperature of your destination. While your local temperature may be high enough for good running, lower temperatures at the destination may cause clouding and plugging.

Do not substitute home heating oil for automotive diesel fuel. While in some cases, home heating oil refinement levels equal those of diesel fuel, many times they are far below diesel engine requirements. The result of using dirty home heating oil will be a clogged fuel system, in which case the entire system may have to be dismantled and cleaned.

One more word on diesel fuels. Don't thin diesel fuel with gasoline in cold weather. The lighter gasoline, which is more explosive, will cause rough running at the very least, and may cause extensive damage to the fuel system if enough is used.

Engine

OIL LEVEL CHECK

➧ See Figures 122, 123, 124, 125 and 126

Check the engine oil level every time you fill the gas tank. The oil level should be above the ADD mark and not above the FULL mark on the dipstick. Make sure that the dipstick is inserted into the crankcase as far as possible and that the vehicle is resting on level ground. Also, allow a few minutes after turning off the engine for the oil to drain into the pan, or an inaccurate reading will result.

1. Open the hood and remove the engine oil dipstick.
2. Wipe the dipstick with a clean, lint-free rag and reinsert it. Be sure to insert it all the way.
3. Pull out the dipstick and note the oil level. It should be between the **SAFE/FULL** (MAX) mark and the **ADD** (MIN) mark.
4. If the level is below the lower mark, insert the dipstick and add fresh oil to bring the level within the proper range. Do not overfill.
5. Recheck the oil level and close the hood.

OIL AND FILTER CHANGE

➧ See Figures 127 and 128

➡You will need a container which is capable of holding a minimum of 7 quarts of oil for gasoline engines or 11 quarts for the diesel. A container which is larger than the oil capacity is recommended so that it can be easily slid out from underneath the truck without the danger of spillage.

✲✲ CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

The oil should be changed more frequently if the vehicle is being operated in very dusty areas. Before draining the oil, make sure that the engine is at operating temperature. Hot oil will hold more impurities in suspension and will flow better, allowing the removal of more oil and dirt.

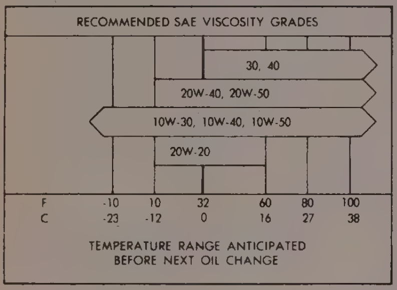

Fig. 121 Diesel engine viscosity chart

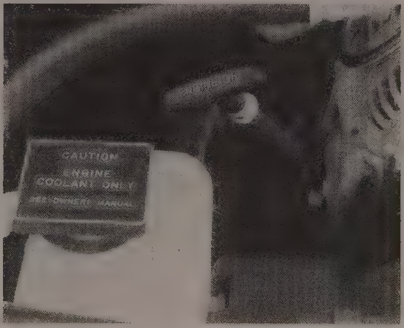

Fig. 122 To get an accurate reading, turn the engine off and wait a few minutes before checking the dipstick

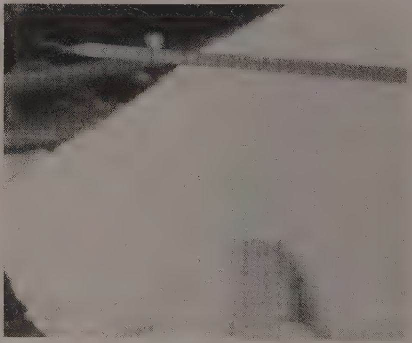

Fig. 123 Remove the dipstick and wipe it dry, then re-insert and remove it again

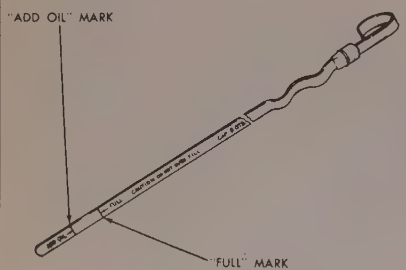

Fig. 124 Check the oil level against the markings on the dipstick

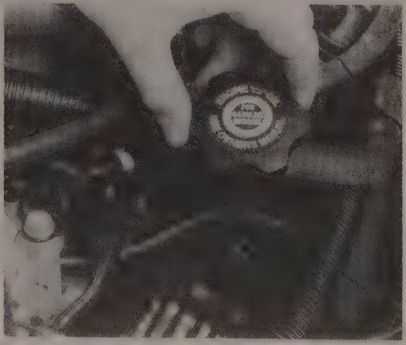

Fig. 125 Remove the oil filler cap from the rocker arm cover to add oil

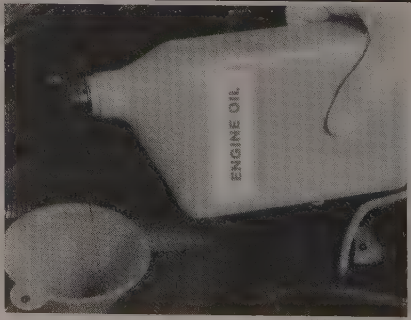

Fig. 126 Even with "easy pour" bottles, it is still wise to use a funnel to keep oil from spilling

➡Though some manufacturers have at times recommended replacement of the filter at every other oil change, Chilton recommends the filter be replaced with each engine oil service. The small amount saved by reusing an oil filter rarely justifies the risk. A clogged or dirty filter may fail to protect the expensive internal parts of your engine.

1. Loosen the drain plug with a wrench.
2. Unscrew the plug using a rag to shield your fingers from the heat. Remove the plug by hand, keeping an inward pressure on it to keep oil from escaping past the threads.
3. Once the plug is unthreaded, quickly pull it and your arm back, away from the hot oil. Watch the oil drain and, if necessary, move the pan to keep it underneath the stream of oil. Be careful of the oil. If it is at operating temperatures, it is hot enough to burn you.
4. Give the oil sufficient time to drain in order to assure you have removed the most oil and dirt possible, then carefully install the drain plug. Make sure the plug is properly tightened, but DO NOT overtighten the plug, as the threads are easily stripped. It is better to leave the plug a little loose than to overtighten and strip the threads.
5. Be sure to check the plug for looseness or seepage after the engine has been fully warmed.

Spin-On Filter Replacement

▶ See Figures 129, 130 and 131

To remove the filter you may need an oil filter wrench, since the filter is often fitted tightly and the heat from the engine may make it even tighter. A filter wrench can be obtained at an auto parts store and is well worth the investment, since it will save you a lot of grief.

➡Oil filter wrenches are available in different size ranges. Be sure to select a wrench of the proper circumference.

1. Position a drain pan under the filter before you start to remove it from the engine; should some of the hot oil happen to get on you, you will have a place to dump the filter in a hurry.
2. Loosen the filter with the filter wrench. With a rag wrapped around the filter, unscrew the filter from the boss on the side of the engine. Be careful of hot oil that will run down the side of the filter.
3. Wipe the base of the mounting boss with a clean, dry cloth.

➡Make sure the old filter gasket was removed with the filter and is not left on the engine adapter. If the old gasket is left in place, you are almost assured to have an oil leak.

4. When you install the new filter, smear a small amount of new engine oil on the gasket with your finger, just enough to coat the entire surface, where it comes in contact with the mounting plate.
5. When you tighten the filter follow the part manufacturer's instructions. If none are provided, tighten it about ½–¾ a turn after it comes in contact with the mounting boss.

Manual Transmission

FLUID RECOMMENDATIONS

NP2500:
- SAE 10W–30 engine oil

NV4500:
- Mopar manual transmission lubricant P/N 4761526 (ONLY)

Mopar AX 15:
- 75W90, API grade GL-5 gear oil

NV3500:
- Mopar manual transmission lubricant P/N 4761526 (ONLY)

Getrag 360:
- SAE 5W-30 engine oil

NP435:
- Below 32°F—SAE 30 engine oil
- 32–100°F—SAE 50 engine oil or SAE 90 gear oil
- 100+°F— SAE 140 gear oil

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Fig. 127 Loosen the oil drain plug with a wrench, then carefully remove it with your fingers

88471P29

Fig. 128 Unscrew the bolt the rest of the way—be cautious with the stream of heated oil that will follow

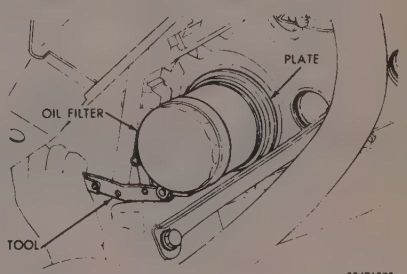

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Fig. 129 Spin-on oil filters are easily removed using a filter wrench, but do not use the wrench for installation; HAND-TIGHTEN the filter

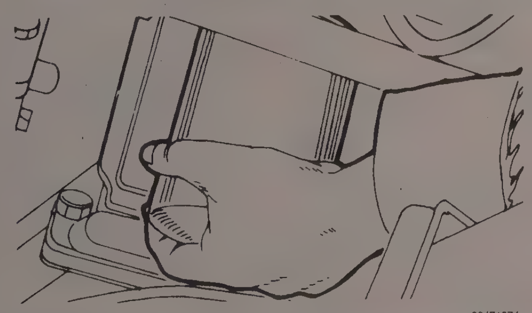
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Fig. 130 Unscrew the oil filter by hand. Remember that it's full of oil which could spill, so keep it opening-side-up

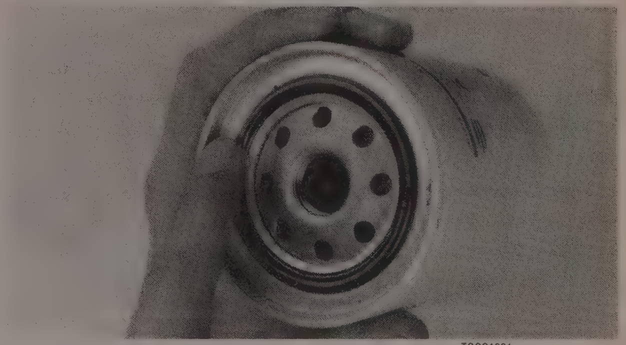
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Fig. 131 Before installing a new oil filter, coat the rubber gasket with clean oil

LEVEL CHECK

➧ See Figures 132 and 133

The fluid level should be checked every 6 months/6,000 miles (9500 km), whichever comes first.

1. Park the truck on a level surface, turn the engine off, apply the parking brake and block the wheels.
2. Remove the filler plug from the side of the transmission case with a proper size wrench. The fluid level should be even with the bottom of the filler hole.
3. If additional fluid is necessary, add it through the filler hole using a siphon pump or squeeze bottle.
4. Install the filler plug; do not overtighten.

DRAIN AND REFILL

➧ See Figure 133

➡Refer to the capacities chart for more information.

1. Position the truck on a level surface.
2. Place a pan of sufficient capacity under the transmission and remove the upper (fill) plug to provide a vent opening.
3. Remove the lower (drain) plug and allow all of the fluid to drain from the transmission.
4. Reinstall the drain plug.
5. Pump in sufficient lubricant to bring the level to the bottom of the filler plug opening.

Automatic Transmission

FLUID RECOMMENDATIONS

All Automatic transmissions covered by this manual, use Dexron®III ATF.

LEVEL CHECK

➧ See Figures 134, 135 and 136

It is very important to maintain the proper fluid level in an automatic transmission. If the level is either too high or too low, poor shifting operation and internal damage are likely to occur. For this reason a regular check of the fluid level is essential.

1. Drive the vehicle for 15–20 minutes to allow the transmission to reach operating temperature.
2. Park the truck on a level surface, apply the parking brake and leave the engine idling. Shift the transmission and engage each gear, then place the gear selector in **P** (PARK).
3. Wipe away any dirt in the area of the transmission dipstick to prevent it from falling into the filler tube. Withdraw the dipstick, wipe it with a clean, lint-free rag and reinsert it until it seats.
4. Withdraw the dipstick and note the fluid level. It should be between the upper (FULL) mark and the lower (ADD) mark.
5. If the level is below the lower mark, use a funnel and add fluid in small quantities through the dipstick filler neck. Keep the engine running while adding fluid and check the level after each small amount. Do not overfill.

DRAIN AND REFILL

➧ See Figures 137 thru 143

1. Raise the front of the truck and support it on jackstands. Place a large drain pan under the transmission.
2. Loosen the pan attaching bolts and tap the pan at one corner to break it loose.
3. Allow the fluid to drain into the drain pan.
4. Loosen the pan attaching bolts, then tap the pan at one corner to break it loose.
5. Allow the fluid to drain into the drain pan.
6. After most of the fluid has drained, carefully remove the attaching bolts, lower the pan and drain the rest of the fluid.

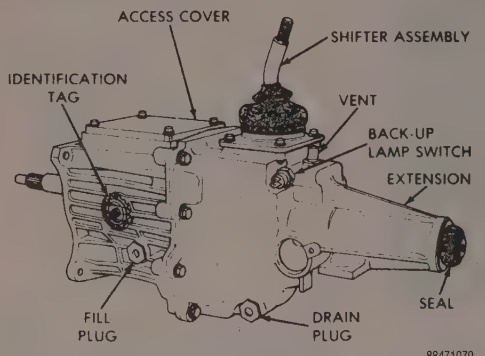

Fig. 132 Details of the New Process NP2500 manual transmission

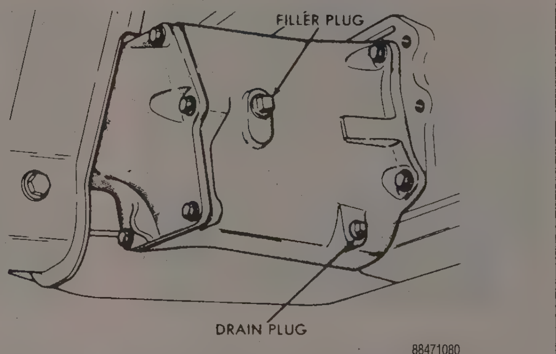

Fig. 133 Drain and refill the NP435 manual transmission at the locations shown

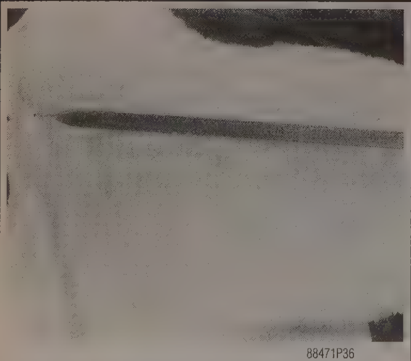

Fig. 134 Check the ATF level against the markings on the dipstick

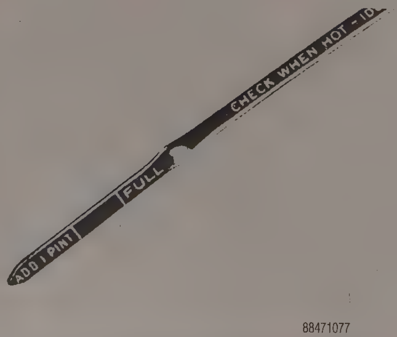

Fig. 135 Automatic transmission dipstick markings

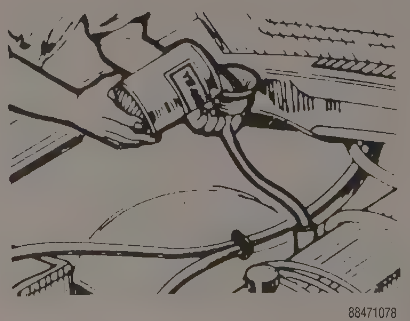

Fig. 136 Use a long-mouth funnel to add fluid to the automatic transmission dipstick tube. Do not overfill

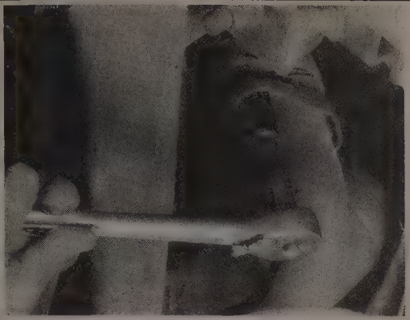
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Fig. 137 Unbolt and remove the exhaust system downpipe if it interferes with the pan removal

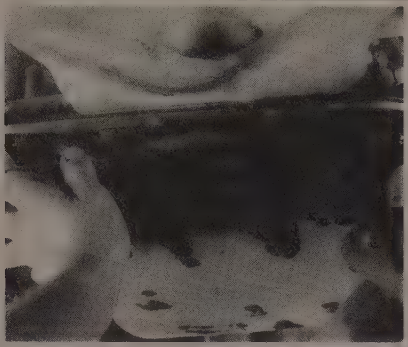
88477P07

Fig. 138 Once all the fasteners are removed, carefully lower the pan

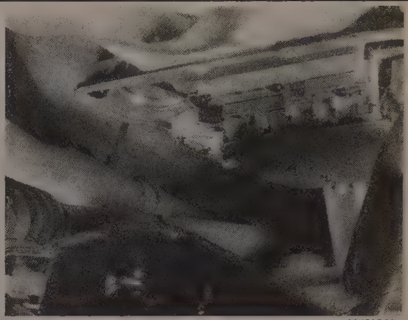
88477P08

Fig. 139 Once you have maneuvered the pan from the vehicle, drain the remaining fluid

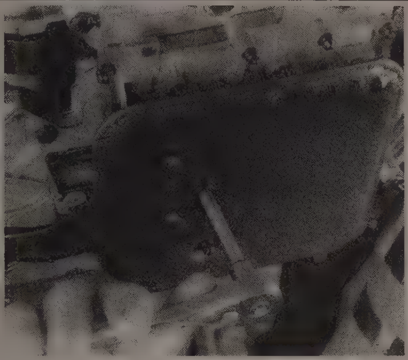
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Fig. 140 Unbolt . . .

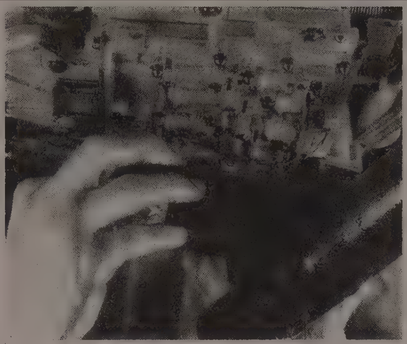
88477P10

Fig. 141 . . . then remove the filter from the transmission

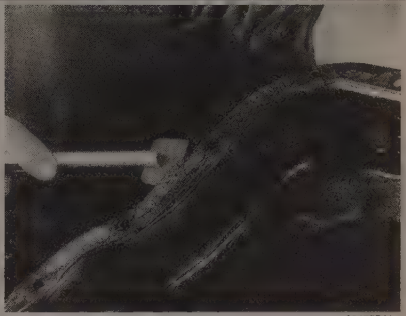
88477P11

Fig. 142 Carefully scrape and clean away all remaining gasket material from the fluid pan before reinstalling

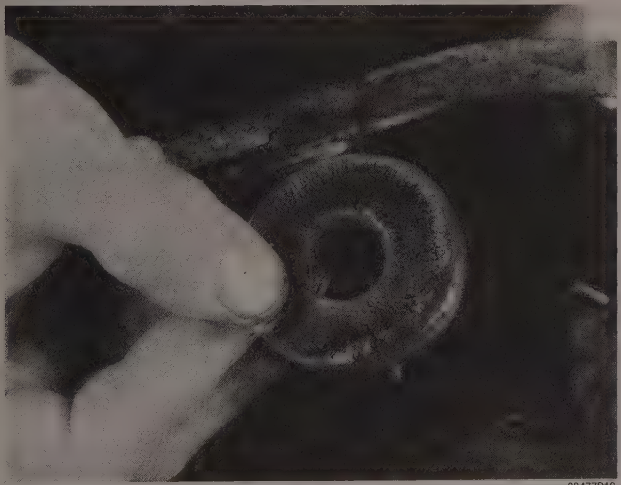
88477P12

Fig. 143 Clean any metal filings attached to the magnet in the base of the pan

7. Remove the filter attaching screws and remove the filter.

To install:

8. Install a new filter. Tighten the screws to 35 inch lbs. (4 Nm).
9. Thoroughly clean the fluid pan with safe solvent and allow it to dry.
10. Using a new gasket, install the pan to the transmission. Tighten the attaching bolts to 150 inch lbs. (17 Nm).
11. Pour 4 quarts of DEXRON®III automatic transmission fluid in through the dipstick tube.
12. Lower the vehicle, start the engine and allow it to run for a few minutes. With the parking brake set, slowly move the gear selector to each position. Return it to the Neutral position.
13. Check the fluid level. Add more fluid as necessary to bring it up to the "ADD ONE PINT" level.
14. Drive the truck to bring the fluid up to normal operating temperature. Check the level again. It should be between the "Add" and "Full" marks.

Transfer Case

FLUID RECOMMENDATIONS

The following lubricants should be used:

NP–205
- SAE SF 10W–30 Engine Oil

NP231/NP241/NP241HD
- Dexron®III ATF

LEVEL CHECK

➧ See Figures 144, 145 and 146

Position the vehicle on level ground. Remove the transfer case fill plug located on the left side of the transfer case. The fluid level should be up to the fill hole. If lubricant doesn't flow from the hold when the plug is removed, add lubricant until it does run out, then install the plug.

DRAIN AND REFILL

➧ See Figures 144, 145 and 146

The transfer case is serviced at the same time and in the same manner as the transmission. Clean the area around the filler and drain plugs and remove the filler plug on the side of the transfer case. Remove the drain plug on the bottom of the transfer case and allow the lubricant to drain completely.

Clean and install the drain plug. Add the proper lubricant. See the section on level checks.

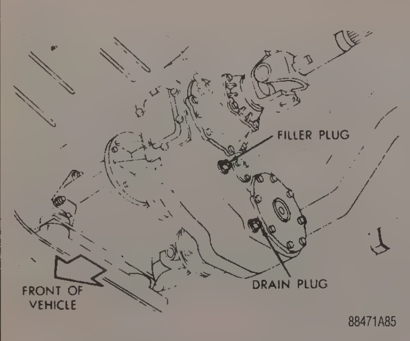

Fig. 144 Transfer case drain and fill plug locations—NP205

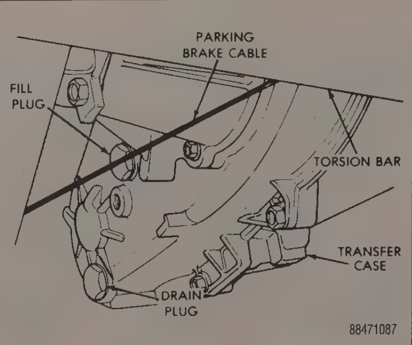

Fig. 145 Transfer case drain and fill plug locations—NP231

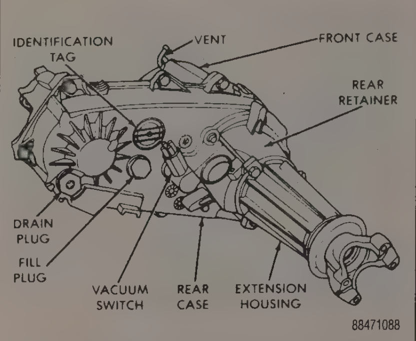

Fig. 146 Transfer case drain and fill plug locations—NP241

Factory Installed Winch

SERVICE RECOMMENDATIONS

▶ See Figure 147

➡Number references for the following winch components correspond to numbers in the accompanying figure.

The winch drum and shaft (1 and 2), along with the driveshaft U-joint (3), require lubrication every 30 usage hours or at least twice a year. Multipurpose grease, NLGI grade 2 E.P. should be used. There are 3 fittings in the drum and shaft. There is one fitting to be lubricated on the driveshaft yoke and shaft spline.

The winch shifter fork and lever (4) use engine oil for lubrication; these also require lubrication every 30 usage hours or at least twice a year.

Winches should also have their cable (5) cleaned after every 300 hours of use. Unwind and wipe the cable down with a rag that has been saturated with engine oil. If the cable has not been used, apply engine oil only to the top layer of the cable on the drum (without unwinding) once a year.

The capacity of the worm housing (6) is ¾ pint. Use SAE 90W gear oil when ambient temperatures are above 10°F (–12°C) or SAE 80W gear oil when below 10°F (–12°C). Fill the unit to the bottom of the filler plug hole. Draining and refilling should be done every 300 usage hours or once a year, whichever comes first.

Drive Axle (Rear and/or Front)

FLUID RECOMMENDATIONS

Multipurpose gear lubricant meeting API GL–5 requirements or MOPAR hypoid lubricant can be used in conventional differential axles. Limited slip units, except in the 9 ¾ in. and 10 ½ in. axles, must use MOPAR hypoid lubricant. A MOPAR friction modifier additive is available to cure chatter and noise in these units.

The 9 ¾ in. and 10½ in. limited slip units must use MOPAR Sure-Grip lubricant. Gear lubricant viscosity depends on the anticipated temperatures: use SAE 140 above 90°F (32°C), SAE 90 for 10–90°F (–12°–32°C), and SAE 80 below 10°F (–12°C). The factory fill is normally SAE 90. Multi-viscosity lubricants may be used. For more information on rear axle identification, please refer to the serial number identification information earlier in this section.

LEVEL CHECK

▶ See Figure 148

To check the axle lubricant level, remove the axle filler plug with the truck parked on a level surface.

You can use a finger for a dipstick, being careful of sharp threads. If necessary, add lubricant with a suction gun. The lubricant level should be ½ in. (13mm) below the filler plug hole on 8¼, 8⅜ and 8¾ in. axles, or at the bottom of the filler plug hole on all the rest.

DRAIN AND REFILL

▶ See Figures 149 and 150

➡Axles on Plymouth and Dodge trucks are not equipped with drain plugs. The old lubricant must be drained by removing the differential housing cover. Use a bead of RTV silicone sealant as a gasket.

Sealant should be applied as follows:

1. Scrape away any remains of the paper gasket or old traces of sealant, as applicable.
2. Clean the cover surface with mineral spirits. Any axle lubricant on the cover or axle housing will prevent the sealant from taking.
3. Apply a 1⁄16–3⁄32 in. (1.6–2.4mm) bead of sealant to the clean and dry cover flange. Apply the bead continuously along the bolt circle of the cover, looping inside the bolt holes as shown.
4. Allow the sealant to air dry.

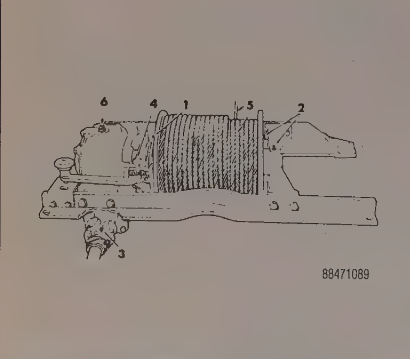

Fig. 147 Winch servicing includes several lubrication points

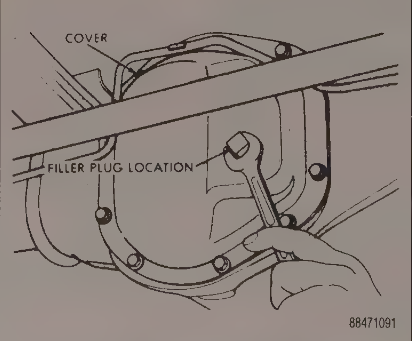

Fig. 148 Remove the filler plug to check the axle lubricant level

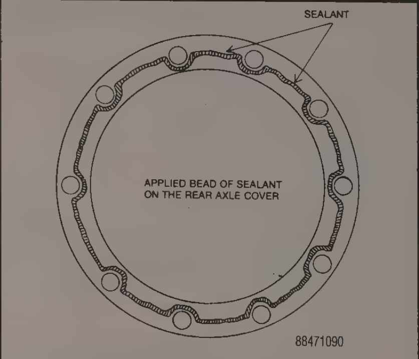

Fig. 149 Apply sealant as shown when replacing the axle cover

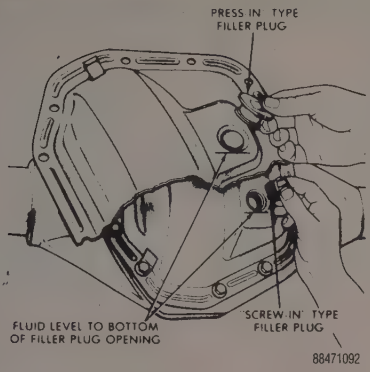
PRESS IN TYPE FILLER PLUG
FLUID LEVEL TO BOTTOM OF FILLER PLUG OPENING
SCREW-IN TYPE FILLER PLUG
88471092

Fig. 150 Common rear axle filler plugs

5. Clean the carrier gasket flange (if solvent is used, allow it to air dry). Install the cover. If, for any reason, the cover is not installed within 20 minutes of applying the sealant, remove the sealant and start over.

Cooling System

CAUTION

Never remove the radiator cap under any conditions while the engine is running! Failure to follow these instructions could result in damage to the cooling system or engine and/or in personal injury. To avoid having scalding hot coolant or steam blow out of the radiator, DO NOT remove the cap from a hot radiator. Wait until the engine has cooled sufficiently, then wrap a thick cloth around the radiator cap and turn it SLOWLY to the first stop. Step back while the pressure is released from the cooling system. When you are sure the pressure has been released, press down on the radiator cap (with the cloth still in position), then turn and remove the cap.

INSPECTION

➧ See Figure 151

At least once every 2 years, the engine cooling system should be inspected, flushed, and refilled with fresh coolant. If the coolant is left in the system too long, it loses its ability to prevent rust and corrosion. If the coolant has been diluted with too much water, it won't protect against freezing.

The radiator cap should be examined for signs of age or deterioration. Fan belts should be inspected and, if necessary, adjusted to the proper tension (please refer to Belt Tension Adjustment in this section).

Hose clamps should be tightened, and soft or cracked hoses replaced. Damp spots, or accumulations of rust or dye near hoses, the water pump or other areas, indicate possible leakage. This must be corrected before filling the system with fresh coolant.

Checking The Radiator Cap

➧ See Figure 152

While you are checking the coolant level, check the radiator cap for a worn or cracked gasket. If the cap doesn't seal properly, fluid will be lost in the form of steam and the engine will overheat. If necessary, replace the cap with a new one.

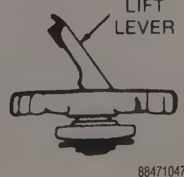

Fig. 151 Lift the lever, if so equipped, to release the system pressure

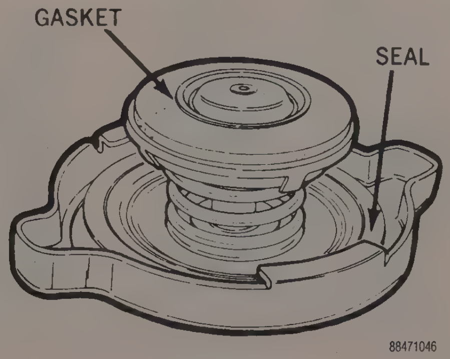

Fig. 152 Check the seal and gasket on the radiator cap

Radiator Debris

Periodically clean any debris (leaves, paper, insects, etc.) from the radiator fins. Pick the large pieces off by hand. The smaller pieces can be washed away with water pressure from a hose.

Carefully straighten any bent radiator fins with a pair of needle nose pliers. Be careful; the fins are very soft! Don't wiggle the fins back and forth too much. Straighten them once and try not to move them again.

FLUID RECOMMENDATIONS

Coolant found in late model trucks is normally a 50/50 mixture of ethylene glycol and water which can be used year round. Always use a good quality antifreeze with water pump lubricants, rust and other corrosion inhibitors, and acid neutralizers. Also available is another type of antifreeze, propylene glycol, which is non-toxic. Keep in mind that should you decide to use a propylene glycol antifreeze, you should follow the antifreeze manufacturer's instructions closely. Do not mix ethylene and propylene glycol together, as the benefits of the non-toxic propylene glycol would be lost. In the event you decide to change to propylene glycol, make sure to completely flush the cooling system of all ethylene glycol traces.

DRAIN & REFILL

The system should be completely drained and refilled at least every two years in order to remove accumulated rust, scale and other deposits.

FLUSHING & CLEANING THE SYSTEM

➧ See Figures 153, 154, 155 and 156

1. Remove the radiator cap. Drain the existing coolant by opening the radiator draincock and engine draincock (if equipped, located on the water pump housing) or by disconnecting the bottom radiator hose at the radiator outlet.

➡Before opening the radiator draincock, spray it with some penetrating lubricant.

2. Close the draincock or reconnect the lower hose and fill the system with water.
3. Add a can of quality radiator flush.
4. Idle the engine until the upper radiator hose gets hot.
5. Drain the system again.
6. Repeat this process until the drained water is clear and free of scale.
7. Close all draincocks and connect all the hoses.
8. If equipped with a coolant recovery system, flush the reservoir with water and leave empty.
9. Determine the capacity of your cooling system (see the Capacities Chart). Add a 50/50 mix of quality antifreeze and water to provide the desired protection.
10. Run the engine to operating temperature.
11. Stop the engine and check the coolant level.
12. Check the level of protection with an antifreeze tester, replace the cap and check for leaks.

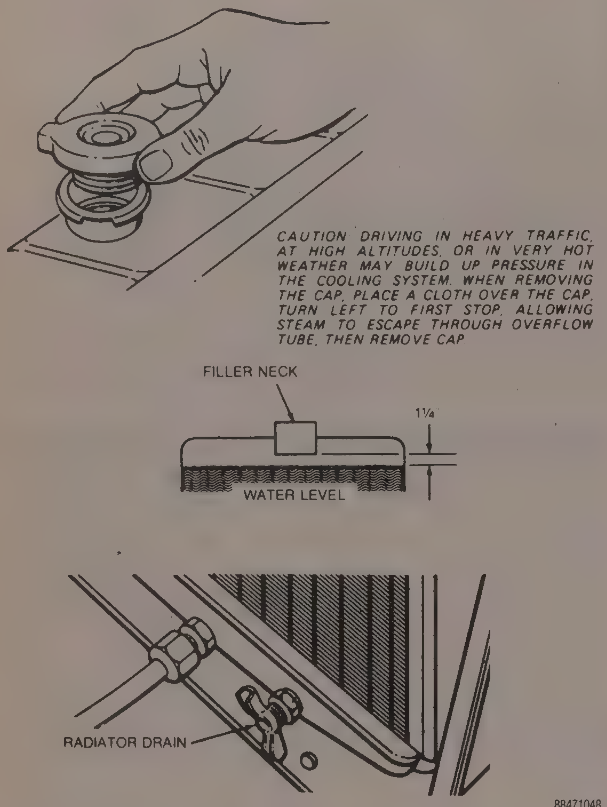
CAUTION DRIVING IN HEAVY TRAFFIC, AT HIGH ALTITUDES, OR IN VERY HOT WEATHER MAY BUILD UP PRESSURE IN THE COOLING SYSTEM. WHEN REMOVING THE CAP, PLACE A CLOTH OVER THE CAP, TURN LEFT TO FIRST STOP, ALLOWING STEAM TO ESCAPE THROUGH OVERFLOW TUBE, THEN REMOVE CAP

Fig. 153 Remember to close the drain valve before refilling, be careful not to overfill the radiator and secure the cap when finished

Brake Master Cylinder

LEVEL CHECK

➧ See Figures 157, 158 and 159

The master cylinder reservoir is located under the hood, on the left side firewall. Make sure the vehicle is resting on level ground. Before removing the reservoir cap, clean all dirt away from the top of the master cylinder. Pry off the retaining clip or unscrew and remove the cap. The brake fluid level should be within ¼ in. (6mm) of the top of the reservoir.

There is a rubber diaphragm in the top of the master cylinder cap. As the fluid level lowers in the reservoir due to normal brake shoe wear or leakage, the diaphragm takes up the space. This is to prevent the loss of brake fluid out the vented cap and/or contamination by dirt. Make sure to inspect this cap for any tears or cracks, it will require replacement if any damage has occurred.

After refilling the master cylinder to the proper level (using heavy duty brake fluid), but before installing the cap, be sure to fold the rubber diaphragm up into the cap. Then install the cap in the reservoir and tighten the retaining bolt or snap the retaining clip into place.

FLUID RECOMMENDATIONS

➧ See Figure 160

Always use brake fluid which is supplied at any of your local parts stores, or even some of your local department stores with an auto parts department. Top off your truck with DOT 3 fluid only. DO NOT use DOT 5 silicone based fluids or rubber parts (seals) in the system will be damaged.

✲✲ WARNING

Do not use old brake fluid that has been sitting on your shelf for any length of time. Brake fluid is hygroscopic, meaning it acts like a sponge to soak up water vapor from the air. Old brake fluid is likely to be water-contaminated which will have a detrimental affect on your braking system.

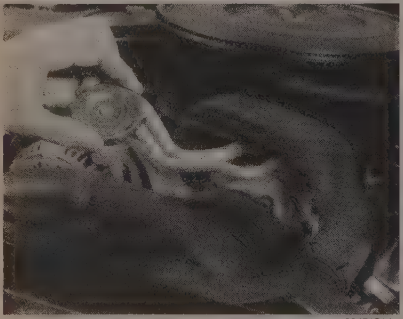

Fig. 154 Only remove the radiator cap when the engine is cool

COOLANT
88471P15

Fig. 155 Fill the system, run the engine, then check and top off as necessary

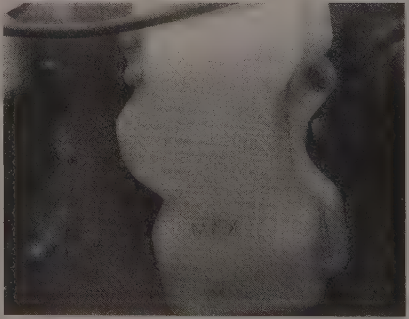

Fig. 156 Check the coolant level in the overflow reservoir

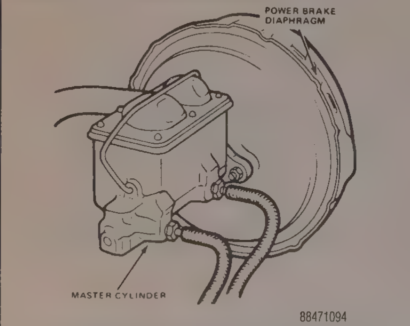

Fig. 157 Brake master cylinder with one-piece cover and metal retainer bar

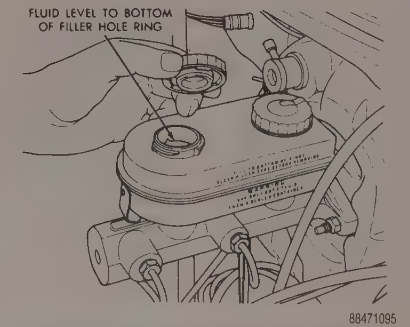

Fig. 158 A master cylinder with screw-on caps

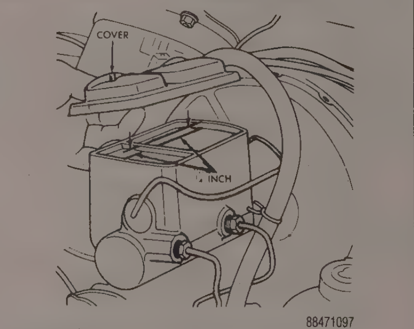

Fig. 159 Check the fluid level in the master cylinder reservoir

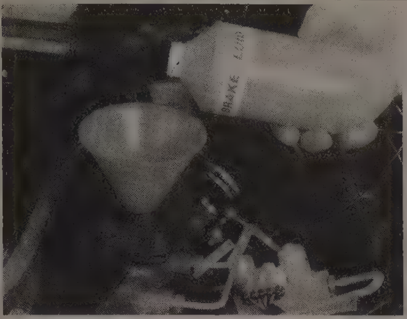
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Fig. 160 Fill the brake master cylinder reservoir to the correct level with NEW clean brake fluid

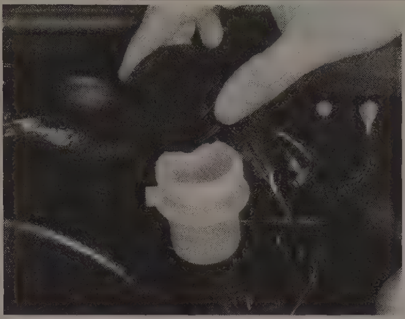
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Fig. 161 Remove the cap to check the clutch master cylinder reservoir's fluid level

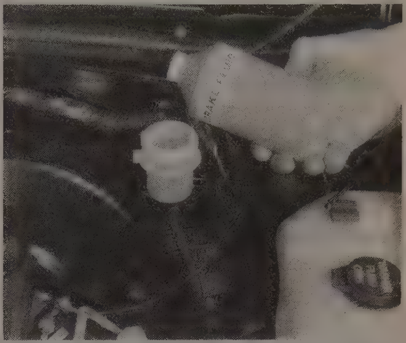
88471P20

Fig. 162 Add fluid as necessary to keep the clutch reservoir at the correct level

If the level of the brake fluid is less than half the volume of the reservoir, it is advised that you check the brake system for leaks. Leaks in the hydraulic brake system most commonly occur at the wheel.

Hydraulic Clutch Reservoir

➧ See Figures 161 and 162

✻✻ WARNING

Do not use old brake fluid that has been sitting on your shelf for any length of time. Brake fluid is hygroscopic, meaning it acts like a sponge to soak up water vapor from the air. Old brake fluid is likely to be water-contaminated which will have a detrimental affect on your braking system.

The clutch master cylinder is very similar to the brake master cylinder. The hydraulic fluid reservoirs on these systems are mounted on the firewall. Fluid level checks are performed like those on the brake hydraulic system. The system should be inspected periodically when other underhood services are performed. The proper fluid level is indicated by a step on the reservoir. To prevent contamination of the system with dirt, ALWAYS clean the top and sides of the reservoir before opening. Remove the reservoir diaphragm before adding fluid, and replace after filling. Keep the reservoir topped up with DOT–3 fluid; do not overfill.

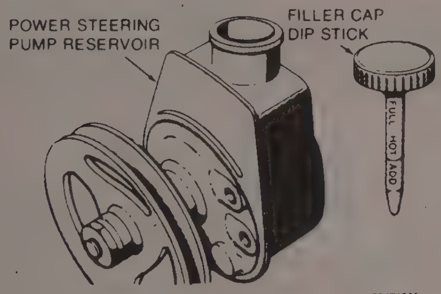

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Fig. 163 Check the fluid level at the power steering reservoir

✻✻ WARNING

Do not allow any petroleum base fluids to enter the clutch hydraulic system, this could cause seal damage.

Power Steering Pump

FLUID RECOMMENDATIONS

If it is necessary to add lubricant, use Chrysler Power Steering Fluid or its equivalent.

LEVEL CHECK

➧ See Figures 163, 164 and 165

➡Always clean the outside of the reservoir cover before removal.

1. Clean and remove the cover from the reservoir.
2. When the fluid is HOT, the level will be approximately ½–1 in. (13–25mm) below the top of the filler neck or at the level indicated on the dipstick.
3. If the fluid is at ROOM TEMPERATURE (approx. 70°F/21°C), the level will be about 1½–2½ in. (38–63mm) below the top of the filler neck.

✻✻ WARNING

Never add gear oil or automatic transmission fluid!

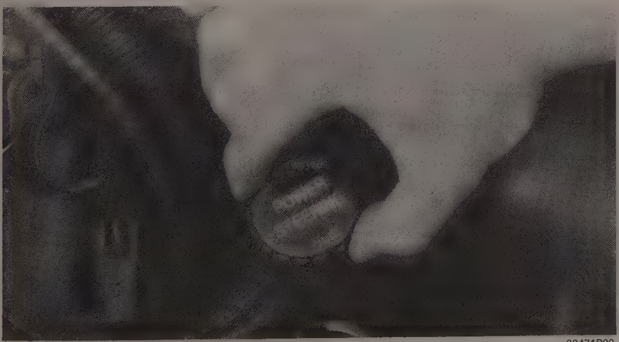
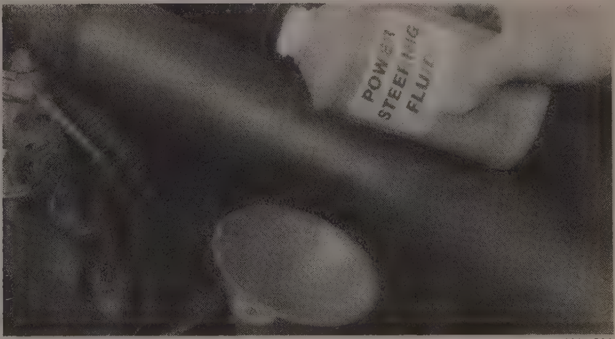

88471P03

Fig. 164 Remove the power steering cap (which in many cases is clearly marked as on this V10 engine)



88471P04

Fig. 165 Add fluid conservatively to top off the system without overfilling

Steering Gear

FLUID RECOMMENDATIONS

If it is necessary to add lubricant, use SAE 90 Gear Oil. In extremely cold weather use SAE 80 Gear Oil or dilute SAE 90 Gear oil with a small amount of SAE 10W engine oil to decrease steering effort. Install the filler plug.

LEVEL CHECK

➡**The trucks covered by this manual are permanently lubricated.**

Chassis Greasing

The lubrication chart indicates where the grease fittings are located. The vehicle should be greased according to the intervals in the Preventive Maintenance Schedule at the end of this section.

Water resistant EP chassis lubricant (grease) conforming to Mopar specification NLGI Grade 2 should be used for all chassis grease points.

Every year or 7,500 miles (12,000 km) the front suspension ball joints, both upper and lower on each side of the truck, must be greased. Most trucks covered in this guide should be equipped with grease nipples on the ball joints, although some may have plugs which must be removed and nipples fitted. These nipples can be obtained through your local parts distributor.

✻✻ WARNING

Do not pump so much grease into the ball joint that excess grease squeezes out of the rubber boot. This destroys the watertight seal.

Jack up the front end of the truck and safely support it with jackstands. Block the rear wheels and firmly apply the parking brake. If the truck has been parked in temperatures below 20°F for any length of time, park it in a heated garage for an hour or so until the ball joints loosen up enough to accept the grease.

Depending on which front wheel you work on first, turn the wheel and tire outward, either full-lock right or full-lock left. You now have the ends of the upper and lower suspension control arms in front of you; the grease nipples are visible pointing up (top ball joint) and down (lower ball joint) through the end of each control arm. If the nipples are not accessible, remove the wheel and tire. Wipe all dirt and crud from the nipples or from around the plugs (if installed). If plugs are on the truck, remove them and install grease nipples in the holes (nipples are available in various thread sizes at most auto parts stores). Using a hand operated, low pressure grease gun loaded with a quality chassis grease, lubricate the ball joint only until the rubber joint boot begins to swell out. DO NOT OVER GREASE!

STEERING LINKAGE

▶ **See Figures 166 and 167**

The steering linkage should be greased at the same interval as the ball joints. Grease nipples are installed on the steering tie rod ends on most models. Wipe all dirt and crud from around the nipples at each tie rod end. Using a hand operated, low pressure grease gun loaded with a suitable chassis grease, lubricate the linkage until the old grease begins to squeeze out around the tie rod ends. Wipe off the nipples and any excess grease. Also lubricate the nipples on the steering idler arms.

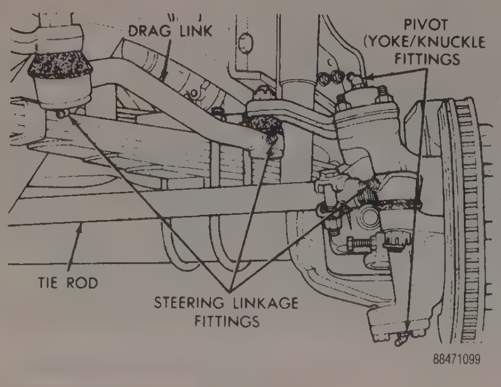


Fig. 166 Steering linkage for a 4WD system

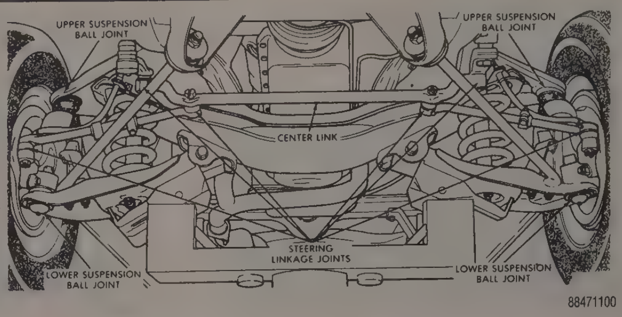

UPPER SUSPENSION BALL JOINT
UPPER SUSPENSION BALL JOINT
CENTER LINK
STEERING LINKAGE JOINTS
LOWER SUSPENSION BALL JOINT
LOWER SUSPENSION BALL JOINT
88471100

Fig. 167 Steering linkage lube fittings—2WD vehicles

PARKING BRAKE LINKAGE

Use chassis grease on the parking brake cable where it contacts the cable guides, levers and linkage.

AUTOMATIC TRANSMISSION LINKAGE

Apply a small amount of clean engine oil to the kickdown and shift linkage points at 7,500 mile (12,000 km) intervals.

Body Lubrication and Maintenance

CARE OF YOUR TRUCK

Glass Surfaces

All glass surfaces should be kept clean at all times for safe driving. You should use a window cleaner, the same cleaner you use on windows in your home. Use caution and never use an abrasive cleaners, this will cause scratching to the window surfaces.

Exterior Care

Your truck is exposed to all kinds of corrosive effects from nature and chemicals. Some of these are road salt, oils, rain, hail and sleet just to name a few. To protect not only the paint and trim, but also the many exposed mounts and fixtures, it is important to wash your vehicle often and thoroughly. After washing, allow all surfaces to drain and dry before parking in a closed garage. Washing may not clean all deposits off your truck, so you may need additional cleaners. When using professional cleaners, make sure they are suitable for acrylic painted surfaces, chrome, tires etc. These supplies can be purchased in your local auto parts store. You also should wax and polish your vehicle every few months to keep the paint in good shape.

HOOD LATCH AND HINGES

▶ **See Figure 168**

Clean the latch surfaces and apply clean engine oil to the latch pilot bolts and the spring anchor. Also lubricate the hood hinges with engine oil. Use a chassis grease to lubricate all the pivot points in the latch release mechanism.

TAILGATE AND DOOR HINGES

▶ **See Figures 169, 170 and 171**

The gas tank filler door and truck doors should be wiped clean and lubricated with clean engine oil once a year. The door lock cylinders and latch mechanisms should be lubricated periodically with a few drops of graphite lock lubricant or a few shots of silicone spray.

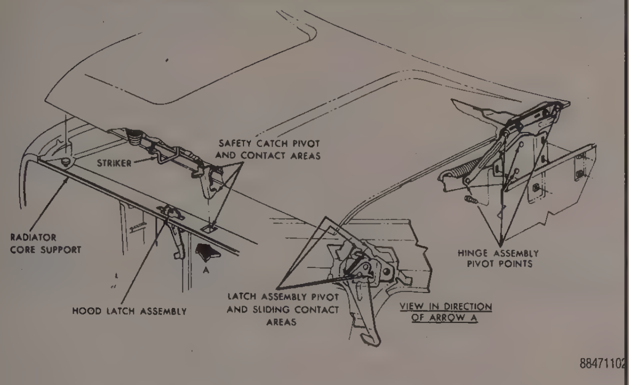

SAFETY CATCH PIVOT AND CONTACT AREAS
STRIKER
RADIATOR CORE SUPPORT
A
HOOD LATCH ASSEMBLY
LATCH ASSEMBLY PIVOT AND SLIDING CONTACT AREAS
VIEW IN DIRECTION OF ARROW A
HINGE ASSEMBLY PIVOT POINTS
88471102

Fig. 168 Hood latch and hinge lubrication points

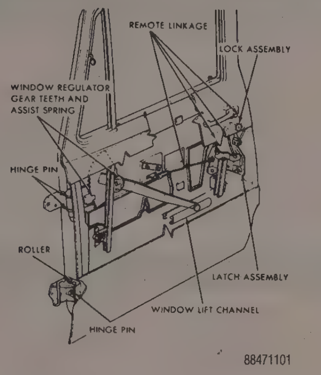

REMOTE LINKAGE
LOCK ASSEMBLY
WINDOW REGULATOR GEAR TEETH AND ASSIST SPRING
HINGE PIN
ROLLER
LATCH ASSEMBLY
WINDOW LIFT CHANNEL
HINGE PIN
88471101

Fig. 169 Door lubrication points

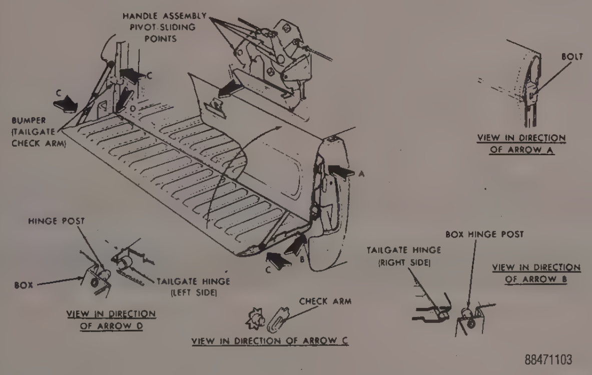

HANDLE ASSEMBLY PIVOT SLIDING POINTS
C
C
D
BUMPER (TAILGATE CHECK ARM)
BOLT
VIEW IN DIRECTION OF ARROW A
A
HINGE POST
BOX
TAILGATE HINGE (LEFT SIDE)
VIEW IN DIRECTION OF ARROW D
C
B
CHECK ARM
VIEW IN DIRECTION OF ARROW C
BOX HINGE POST
TAILGATE HINGE (RIGHT SIDE)
VIEW IN DIRECTION OF ARROW B
88471103

Fig. 170 Tailgate lubrication points

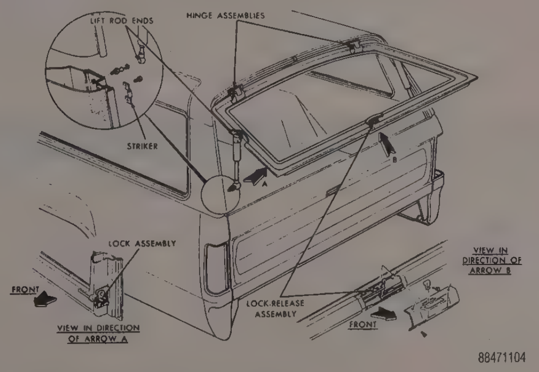

LIFT ROD ENDS
HINGE ASSEMBLIES
STRIKER
A
B
LOCK ASSEMBLY
FRONT
VIEW IN DIRECTION OF ARROW A
LOCK-RELEASE ASSEMBLY
FRONT
VIEW IN DIRECTION OF ARROW B
88471104

Fig. 171 Liftgate lubrication points

Front Wheel Bearings

REPACKING

See Figures 172, 173 and 174

➡Sodium based grease is not compatible with lithium based grease. Read the package labels and be careful not to mix the two types. If there is any doubt as to the type of grease used, completely clean the old grease from the bearing and hub before replacing.

Before handling the bearings, there are a few things that you should remember to do and not to do.

DO the following:

- Remove all outside dirt from the housing before exposing the bearing.
- Treat a used bearing as gently as you would a new one.
- Work with clean tools in clean surroundings.
- Use clean, dry gloves, or at least clean, dry hands.
- Clean solvents and flushing fluids are a must.
- Use clean paper when laying out the bearings to dry.
- Protect disassembled bearings from rust and dirt. Cover them up.
- Use clean, lint-free rags to wipe the bearings.
- Keep the bearings in oil-proof paper when they are to be stored or are not in use.
- Clean the inside of the housing before replacing the bearing.

Do NOT do the following:

- Do not work in dirty surroundings.
- Do not use dirty, chipped or damaged tools.
- Do not work on wooden work benches or use wooden mallets.
- Do not handle bearings with dirty or moist hands.
- Do not use gasoline for cleaning. Use a safe solvent.
- Do not spin dry bearings with compressed air. They will be damaged.
- Do not use cotton waste or dirty cloths to wipe bearings.
- Do not scratch or nick bearing surfaces.
- Do not allow the bearing to come in contact with dirt or rust at any time.

➡For information on Wheel Bearing removal and installation, refer to Section 7 of this manual.

1. On 4WD models, remove the hub assembly. Refer to Section 7.
2. Remove the wheel bearing.
3. Clean all parts in a non-flammable solvent and let them air dry.

➡Only use lint-free rags to dry the bearings. Never spin-dry a bearing with compressed air, as this will damage the rollers.

4. Check for excessive wear and damage. Replace the bearing as necessary.

➡Packing wheel bearings with grease is best accomplished by using a wheel bearing packer (available at most automotive parts stores).

5. If a wheel bearing packer is not available, the bearings may be packed by hand.
   a. Place a "healthy" glob of grease in the palm of one hand.
   b. Force the edge of the bearing into the grease so that the grease fills the space between the rollers and the bearing cage.

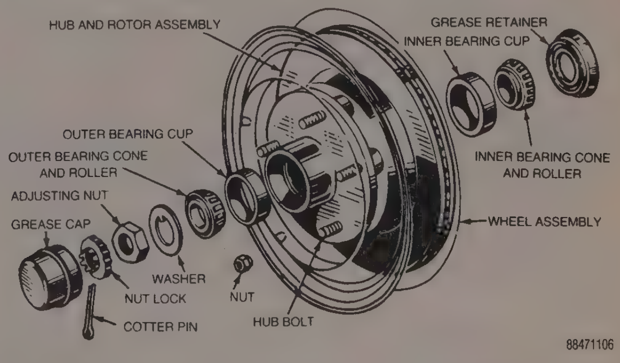
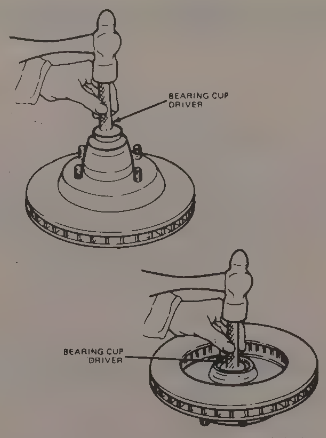

HUB AND ROTOR ASSEMBLY
GREASE RETAINER
INNER BEARING CUP
OUTER BEARING CUP
OUTER BEARING CONE AND ROLLER
INNER BEARING CONE AND ROLLER
ADJUSTING NUT
GREASE CAP
WHEEL ASSEMBLY
WASHER
NUT LOCK
NUT
HUB BOLT
COTTER PIN
88471106

Fig. 172 Exploded view of 2WD front wheel and bearing assembly

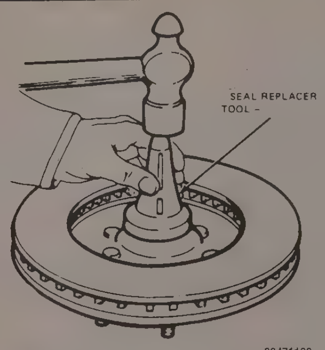


88471107

Fig. 173 Remove the 2WD front bearing using a suitable driver

c. Keep rotating the bearing while continuing to push the grease through.
d. Continue until the grease is forced out the other side of the bearing.

6. Place the packed bearing on a clean surface and cover it until it is time for installation.
7. Install the wheel bearing.
8. Install the hub assembly, refer to Section 7.



88471108

Fig. 174 Press in the bearing races using a driver of suitable diameter—special factory tool shown

Automatic Locking Hubs

LUBRICATION

➡The hubs should be lubricated every 24,000 miles (38,600 km), or, after being run in deep water. For removal and installation refer to Section 7. All parts except the bearing and race, brake band and drag sleeve, should be dipped in clean Dexron®II ATF prior to assembly.

TRAILER TOWING

General Recommendations

Your vehicle was primarily designed to carry passengers and cargo. It is important to remember that towing a trailer will place additional loads on your vehicles engine, drive train, steering, braking and other systems. However, if you decide to tow a trailer, using the prior equipment is a must.

Local laws may require specific equipment such as trailer brakes or fender mounted mirrors. Check your local laws.

Trailer Weight

The weight of the trailer is the most important factor. A good weight-to-horsepower ratio is about 35:1, 35 lbs. of Gross Combined Weight (GCW) for every horsepower your engine develops. Multiply the engine's rated horsepower by 35 and subtract the weight of the vehicle passengers and luggage. The number remaining is the approximate ideal maximum weight you should tow, although a numerically higher axle ratio can help compensate for heavier weight.

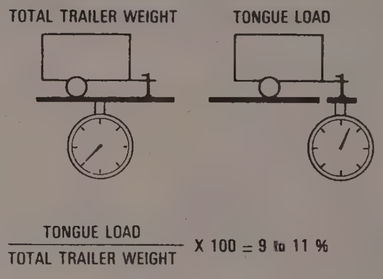
Hitch (Tongue) Weight

➧ See Figure 175

Calculate the hitch weight in order to select a proper hitch. The weight of the hitch is usually 9–11% of the trailer gross weight and should be measured with the trailer loaded. Hitches fall into various categories: those that mount on the frame and rear bumper, the bolt-on type, or the weld-on distribution type used for larger trailers. Axle mounted or clamp-on bumper hitches should never be used.

Check the gross weight rating of your trailer. Tongue weight is usually figured as 10% of gross trailer weight. Therefore, a trailer with a maximum gross weight of 2000 lbs. will have a maximum tongue weight of 200 lbs. Class I trailers fall into this category. Class II trailers are those with a gross weight rating of 2000–3000 lbs., while Class III trailers fall into the 3500–6000 lbs. category. Class IV trailers are those over 6000 lbs. and are for use with fifth wheel trucks, only.

When you've determined the hitch that you'll need, follow the manufacturer's installation instructions, exactly, especially when it comes to fastener torques. The hitch will subjected to a lot of stress and good hitches come with hardened bolts. Never substitute an inferior bolt for a hardened bolt.



TCCS1005

Fig. 175 Calculating proper tongue weight for your trailer

Cooling

ENGINE

Aftermarket engine oil coolers are helpful for prolonging engine oil life and reducing overall engine temperatures. Both of these factors increase engine life. While not absolutely necessary in towing Class I and some Class II trailers, they are recommended for heavier Class II and all Class III towing. Engine oil cooler systems usually consist of an adapter, screwed on in place of the oil filter, a remote filter mounting and a multi-tube, finned heat exchanger, which is mounted in front of the radiator or air conditioning condenser.

Transmission

An automatic transmission is usually recommended for trailer towing. Modern automatics have proven reliable and, of course, easy to operate, in trailer towing. The increased load of a trailer, however, causes an increase in the temperature of the transmission fluid. Heat is the worst enemy of an automatic transmission. As the temperature of the fluid increases, the life of the fluid decreases.

It is essential, therefore, that you install an automatic transmission cooler and that you pay close attention to transmission fluid changes. The cooler, which consists of a multi-tube, finned heat exchanger, is usually installed in front of the radiator or air conditioning compressor, and hooked in-line with the transmission cooler tank inlet line. Follow the cooler manufacturer's installation instructions.

JUMP STARTING A DEAD BATTERY

➧ See Figure 176

Whenever a vehicle is jump started, precautions must be followed in order to prevent the possibility of personal injury. Remember that batteries contain a small amount of explosive hydrogen gas which is a by-product of battery charging. Sparks should always be avoided when working around batteries, especially when attaching jumper cables. To minimize the possibility of accidental sparks, follow the procedure carefully.

✻✻ CAUTION

NEVER hook up the batteries in a series circuit or the entire electrical system, including the starter, will go up in smoke!

Cars equipped with a diesel engine may utilize two 12 volt batteries. If so, the batteries are connected in a parallel circuit (positive terminal to positive terminal, negative terminal to negative terminal). Hooking the batteries up in parallel circuit increases battery cranking power without increasing total battery voltage output. Output remains at 12 volts. On the other hand, hooking two 12 volt batteries up in a series circuit (positive terminal to negative terminal, positive terminal to negative terminal) increases total battery output to 24 volts (12 volts plus 12 volts).

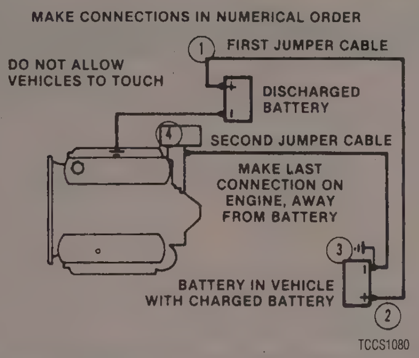

MAKE CONNECTIONS IN NUMERICAL ORDER
①
FIRST JUMPER CABLE
DO NOT ALLOW VEHICLES TO TOUCH
DISCHARGED BATTERY
④
SECOND JUMPER CABLE
MAKE LAST CONNECTION ON ENGINE, AWAY FROM BATTERY
③
BATTERY IN VEHICLE WITH CHARGED BATTERY
②
TCCS1080

Fig. 176 Connect the jumper cables to the batteries and engine in the order shown

Jump Starting Precautions

- Be sure that both batteries are of the same voltage. Vehicles covered by this manual and most vehicles on the road today utilize a 12 volt charging system.
- Be sure that both batteries are of the same polarity (have the same terminal, in most cases NEGATIVE grounded).
- Be sure that the vehicles are not touching or a short could occur.
- On serviceable batteries, be sure the vent cap holes are not obstructed.
- Do not smoke or allow sparks anywhere near the batteries.
- In cold weather, make sure the battery electrolyte is not frozen. This can occur more readily in a battery that has been in a state of discharge.
- Do not allow electrolyte to contact your skin or clothing.

Jump Starting Procedure

1. Make sure that the voltages of the two batteries are the same. Most batteries and charging systems are of the 12 volt variety.
2. Pull the jumping vehicle (with the good battery) into a position so the jumper cables can reach the dead battery and that vehicle's engine. Make sure that the vehicles do NOT touch.
3. Place the transmissions of both vehicles in **NEUTRAL** or **PARK**, as applicable, then firmly set their parking brakes.

➡If necessary for safety reasons, the hazard lights on both vehicles may be operated throughout the entire procedure without significantly increasing the difficulty of jumping the dead battery.

4. Turn all lights and accessories off on both vehicles. Make sure the ignition switches on both vehicles are turned to the **OFF** position.
5. Cover the battery cell caps with a rag, but do not cover the terminals.
6. Make sure the terminals on both batteries are clean and free of corrosion or proper electrical connection will be impeded. If necessary, clean the battery terminals before proceeding.
7. Identify the positive (+) and negative (–) terminals on both battery posts.
8. Connect the first jumper cable to the positive (+) terminal of the dead battery, then connect the other end of that cable to the positive (+) terminal of the booster (good) battery.
9. Connect one end of the other jumper cable to the negative (–) terminal on the booster battery and the other cable clamp to an engine bolt head, alternator bracket or other solid, metallic point on the engine with the dead battery. Try to pick a ground on the engine that is positioned away from the battery in order to minimize the possibility of the two clamps touching should one loosen during the procedure. DO NOT connect this clamp to the negative (–) terminal of the bad battery.

✻✻ CAUTION

Be very careful to keep the jumper cables away from moving parts (cooling fan, belts, etc.) on both engines.

10. Check to make sure that the cables are routed away from any moving parts, then start the donor vehicle's engine. Run the engine at moderate speed for several minutes to allow the dead battery a chance to receive some initial charge.
11. With the donor vehicle's engine still running slightly above idle, try to start the vehicle with the dead battery. Crank the engine for no more than 10 seconds at a time and let the starter cool for at least 20 seconds between tries. If the vehicle does not start in 3 tries, it is likely that something else is also wrong or that the battery needs additional time to charge.
12. Once the vehicle is started, allow it to run at idle for a few seconds to make sure that it is operating properly operating.
13. Turn on the headlights, heater blower and, if equipped, the rear defroster of both vehicles in order to reduce the severity of voltage spikes and subsequent risk of damage to the vehicles' electrical systems when the cables are disconnected. This step is especially important to late model vehicles equipped with computer control modules.
14. Carefully disconnect the cables in the reverse order of connection. Start with the negative cable that is attached to the engine ground, then the negative cable on the donor battery. Disconnect the positive cable from the donor battery and finally, disconnect the positive cable from the formerly dead battery. Be careful when disconnecting the cables from the positive terminals not to allow the alligator clips to touch any metal on either vehicle or a short and sparks will occur.

JACKING

➧ See Figures 177, 178 and 179

Your vehicle was supplied with a jack for emergency road repairs. This jack is fine for changing a flat tire or other operations not requiring you to go beneath the vehicle. If it is used in an emergency situation, carefully follow the instructions provided either with the jack or in your owner's manual. Do not attempt to use the jack in any places other than specified by the vehicle manufacturer. Always block the diagonally opposite wheel when using a jack.

A more convenient way of jacking is the use of a garage or floor jack. You may use the floor jack only at approved jacking points.

Never place the jack under the radiator, engine or transmission components. Severe and expensive damage will result when the jack is raised. Additionally, never jack under the floorpan or bodywork; the metal will deform.

Whenever you plan to work under the vehicle, you must support it on jackstands or ramps. Never use cinder blocks or stacks of wood to support the vehicle, even if you're only going to be under it for a few minutes. Never crawl under the vehicle when it is supported only by the tire-changing jack or other floor jack.

➡Always position a block of wood on top of the jack or stand to protect the finish when lifting or supporting the vehicle.

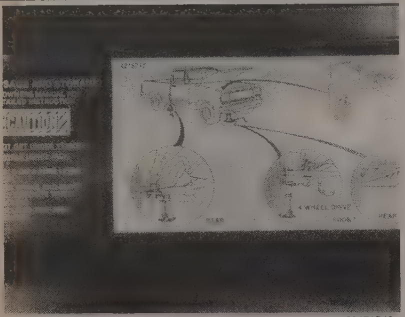

88471P45

Fig. 177 When raising and supporting the vehicle, be sure to only use approved jacking points

88471P43

Fig. 178 A good quality floor jack is very handy when servicing these relatively heavy vehicles

88471P44

Fig. 179 Use sturdy jackstands to securely support the vehicle

Small hydraulic, screw, or scissors jacks are satisfactory for raising the vehicle. Drive-on trestles or ramps are also a handy and safe way to both raise and support the vehicle. Be careful though, some ramps may be too steep to drive your vehicle onto without scraping the front bottom panels. Never support the vehicle on any suspension member (unless specifically instructed to do so by a repair manual) or underbody panel.

The following safety points cannot be overemphasized:

- Always block the opposite wheel or wheels to keep the vehicle from rolling off the jack.
- When raising the front of the vehicle, firmly apply the parking brake.
- Always use jackstands to support the vehicle when you are working underneath. Place the stands beneath the scissors jacking brackets. Before climbing underneath, rock the vehicle a bit to make sure it is firmly supported.

MAINTENANCE INTERVAL CHARTS

The manufacturer provides maintenance schedules for its light duty, heavy duty and diesel vehicles. If the vehicle is subjected to severe service, the maintenance should be performed more frequently. "Severe service" recommendations are actually provided by Chrysler Corp. for 1994–96 vehicles. Although severe service charts are not provided for 1989–93 vehicles, the same rule of thumb should be applied. Severe service is considered to apply if the vehicle is operated under one or more of the following conditions:

- Frequent short trip driving of less than 5 miles (8 km).
- Frequent driving in dusty conditions.
- Trailer towing or heavy load hauling.
- Frequent long periods of engine idling.
- Sustained high speed operation.
- Desert operation.
- Frequent starting or stopping.
- Cold climate operation.
- Off-road driving.
- Commercial service.
- Snow plow operation.
- More than half of the vehicle operation occurs in heavy city traffic during hot weather (above 90°F/32°C).

MANUFACTURER RECOMMENDED MAINTENANCE INTERVALS
(1989-93 LIGHT DUTY)

SCHEDULED MAINTENANCE FOR EMISSIONS CONTROL — PROPER VEHICLE PERFORMANCE

Inspection and service is also necessary any time a malfunction is observed or suspected.

X = Scheduled maintenance for all vehicles.
O = Scheduled maintenance for all vehicles, Recommended for proper vehicle performance.

Where both time and mileage are shown, follow the interval which occurs first. Miles (Thousand)	7½	15	22½	30	37½	45	52½	60	67½	75	82½	90	97½	105	112½	120
Kilometers (Thousand)	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192
Coolant Condition, Coolant Hoses/Clamps	X	X	X	X	X	X	O	O	O	O	O	O	O	O	O	O
Exhaust System—Check	X	X	X	X	X	X	O	O	O	O	O	O	O	O	O	O
Oil—Change (6 months)	X	X	X	X	X	X	O	O	O	O	O	O	O	O	O	O
Oil Filter—Change (2nd Oil Change)		X		X		X		O		O		O		O		O
Spark Plug—Replace				X				O				O				O
Air Filter—Replace				X				O				O				O
Coolant—Flush/Replace (36 months) & 24 months/48 000 km (30,000 miles) thereafter							O				X				X	
PCV Valve—Replace if Necessary								O[1]			O[1]					O[1]
Battery—Replace								O								

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[1] This maintenance is recommended by Chrysler Corporation to the owner, but is not required to maintain the warranty.

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MANUFACTURER RECOMMENDED MAINTENANCE INTERVALS
(1989-93 HEAVY DUTY)

Inspection and service is also necessary anytime a malfunction is observed or suspected.

Where both time and mileage are shown, follow the interval which occurs first. Miles (Thousand)	6	12	18	24	30	36	42	48	54	60	66	72	78	82½	84	90	96	102	108
Kilometers (Thousand)	9.6	19	29	38	48	58	67	77	85	96	106	116	125	132	135	145	154	164	174
Coolant Condition, Coolant Hoses/Clamps	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Exhaust System — Check	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Oil — Change (6 Months)	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Oil Filter — Change (2nd Oil Change)		X		X		X		X		X		X			X		X		X
Drive Belt Tension — Inspect & Adjust			X[1]			X			X[1]			X				X[1]			X
Drive Belts (V-Type) — Replace									X										
Air Filter/Air Pump Air Filter — Replace				X				X				X				X			
Crankcase Inlet Air Filter (6 & 8 Cyl. Eng. Only) — Clean				X				X				X					X		
Spark Plug — Replace					X					X						X			
Fuel Filter — Replace as necessary																			
Coolant — Flush/Replace (36 months) & 24 months/48 000 km (30,000 miles) thereafter									X										
EGR Valve & Tube — Replace										X[2]									
EGR Tube — Clean Passengers										X[2]									
PCV Valve — Replace										X[2]									
Vacuum Emission Components — Replace										X									
Ignition Timing — Adjust to Specs, as necessary										X									
Ignition Cables, Distributor Cap & Rotor — Replace										X									
Manifold Heat Control Valve — Lubricate										X									
Battery — Replace										X									
Oxygen Sensor — Replace														X[2]					

[1] For California vehicles, this maintenance is recommended by Chrysler Motors to the owner but, is not required to maintain the warranty on the air pump drive belt.

[2] Requires Emission Maintenance Reminder Light. If so equipped, these parts are to be replaced at the indicated mileage, or when the emissions maintenance reminded light remains on continuously with the key in the "on" position, whichever occurs first.

88471C23

MANUFACTURER RECOMMENDED MAINTENANCE INTERVALS
(1989-93 DIESEL ENGINES)

HEAVY DUTY CYCLE

Inspection and service is also necessary any time a malfunction is observed or suspected.

If both time and distance are listed, use the interval that ends first. Miles (Thousand)	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108
Kilometers (Thousand)	9.6	19	29	38	48	58	67	77	85	96	106	116	125	135	145	154	164	174
Coolant Condition, Coolant Hoses/Clamps (12 months)																		
Coolant Flush/Replace (36 months) & 24 months/ 48 000 km (30,000 miles) thereafter								O										
Oil—Change (6 months)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Oil Filter—Replace (Every Oil Change)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Drive Belts—Replace As Necessary			X			X			X			X			X			X
Air Filter—Replace				X				X				X				X		
Air Filter—Clean (California Only)		•				•				•				•				•
Air Filter Canister—Clean			O				O				O				O			
Fuel Filter—Service When Necessary																		
Injection Pump Timing & Engine Idle Speed—Check & Adjust			•			•			•			•			•			•
Underhood Rubber/Plastic Components—Inspect/Replace					•			•			•			•			•	

X — All vehicles O — All vehicles except California. Recommended for California • — California only Recommended for all vehicles

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MANUFACTURER RECOMMENDED MAINTENANCE INTERVALS (1994-96 LIGHT DUTY)

	TYPE OF SERVICE	VEHICLE MILEAGE INTERVAL (x1000)													
		7.5	15	22.5	30	37.5	45	52.5	60	67.5	75	82.5	90	97.5	miles
		12	24	36	48	60	72	84	96	108	120	132	144	156	km
TO BE SERVICED		6	12	18	24	30	36	42	48	54	60	66	72	78	months
Engine oil	D/R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Engine oil filter ①	R		✓		✓		✓		✓		✓		✓		
Front wheel bearings ②	S/I			✓			✓			✓			✓		
Brake linings	S/I			✓			✓			✓			✓		
Air cleaner element ③	R				✓				✓				✓		
Spark plugs ③	R				✓				✓				✓		
ATF / Replace filter, adjust bands	D/R					✓					✓				
Transfer case fluid	D/R					✓					✓				
Engine Coolant ④	R/F						✓								
Distributor cap and rotor ③	R								✓						
Ignition wires ③	R								✓						
PCV valve. Replace if nec. ③	S/I								✓						
Crankcase inlet air filter	C/L								✓						

R - Replace
S/I - Service or Inspect
R/F - Replace and flush system
D/R - Drain and refill
C/L - Clean and lubricate

1 - If your total distance is less than 7500 mi. (12,000 km) yearly, replace the engine oil filter at each oil change.
2 - Clean and repack if required (4x2).
3 - Emission Control System Maintenance is listed in **bold type.** Service must be performed on-schedule to assure continued proper functioning of the system.
4 - Flush and refill at 36 mos. regardless of miles, then every 24 mos./30,000 mi. (48,000 km) thereafter

AT EACH OIL CHANGE

Inspect the exhaust system.
Inspect the brake hoses.
Rotate the tires.
Check engine coolant level, hoses and clamps.
Lubricate steering linkage.
If applicable, lubricate the driveshaft universal joints and slip spline at each oil change.
After completion of off-road (4WD) operation, the underside of the vehicle should be thoroughly inspected. Examine threaded fasteners for looseness.

88471C11

MANUFACTURER RECOMMENDED MAINTENANCE INTERVALS (1994-96 LIGHT DUTY-SEVERE SERVICE)

	TYPE OF SERVICE	VEHICLE MILEAGE INTERVAL (x1000)													
		3	6	9	12	15	18	21	24	27	30	33	36	39	miles ⑥
TO BE SERVICED		5	10	14	19	24	29	34	39	43	48	53	58	63	km
Engine oil	D/R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Engine oil filter ①	R		✓		✓		✓		✓		✓		✓		
Front wheel bearings ②	S/I			✓			✓			✓			✓		
Brake linings	S/I				✓				✓				✓		
Air cleaner element ③	R										✓		✓		
Spark plugs ③	R										✓		✓		
ATF / Replace filter, adjust bands	D/R				✓ ④				✓ ④				✓ ④		
Rear axle fluid	R				✓				✓						
Front axle fluid (4x4)	R				✓				✓						
Transfer case fluid	D/R					✓					✓				
Engine Coolant ⑤	R/F														

R - Replace
S/I - Service or Inspect
R/F - Replace and flush system
D/R - Drain and refill

1 - If your distance travelled is less than 7500 mi. (12,000 km) yearly, replace the engine oil filter at each oil change.
2 - Clean and repack if required (4x2).
3 - Emission Control System Maintenance is listed in **bold type.** Service must be performed on-schedule to assure continued proper functioning of the system.
4 - Off-the-highway operation, trailer towing, snow plowing, prolonged operation with heavy loading, especially in hot weather require more frequent transmission service.
5 - Flush and refill at 36 mos. regardless of miles, then every 24 mos./30,000 mi. (48,000 km) thereafter.
6 - Observe the same maintenance intervals for mileage beyond that which appears on this chart.

AT EACH OIL CHANGE

Inspect the exhaust system.
Inspect the brake hoses.
Check engine coolant level, hoses and clamps.
Lubricate steering linkage
If applicable, lubricate the driveshaft universal joints and slip spline at each oil change.
After completion of off-road (4WD) operation, the underside of the vehicle should be thoroughly inspected. Examine threaded fasteners for looseness.

AT EVERY OTHER OIL CHANGE

Rotate the tires.

88471C12

MANUFACTURER RECOMMENDED MAINTENANCE INTERVALS (1994-96 HEAVY DUTY)

TO BE SERVICED	TYPE OF SERVICE	VEHICLE MILEAGE INTERVAL (x1000)													
		6	12	18	24	30	36	42	48	54	60	66	72	78	miles ⑨
		10	19	29	38	48	58	67	77	86	96	106	115	125	km
		6	12	18	24	30	36	42	48	54	60	66	72	78	months
Engine oil	D/R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Engine oil filter ①	R	✓ ②	✓	✓ ②	✓	✓ ②	✓	✓ ②	✓	✓ ②	✓	✓ ②	✓	✓ ②	
Front wheel bearings ③	S/I				✓				✓				✓		
Brake linings	S/I						✓						✓		
Air cleaner and air pump elements ④	R				✓				✓				✓		
Spark plugs ④	R										✓				
ATF / Replace filter, adjust bands	D/R				✓ ⑥				✓ ⑥				✓ ⑥		
Transfer case fluid	D/R				✓				✓				✓		
Engine Coolant ⑤	F/R						✓				✓				
Distributor cap and rotor ④	R										✓ ⑦				
Ignition wires ④	R										✓				
PCV valve ④	R										✓ ⑦				
Crankcase inlet air filter ⑧	C/L				✓				✓				✓		

R - Replace
S/I - Service or Inspect
F/R - Flush and refill
D/R - Drain and refill
C/L - Clean and lubricate

1 - If your distance travelled is less than 6000 mi. (9600 km) yearly, replace the engine oil filter at each oil change
2 - 8.0L only
3 - Clean and repack if required (4x2).
4 - Emission Control System Maintenance is listed in **bold type.** Service must be performed on-schedule to assure continued proper functioning of the system.
5 - Flush and refill at 36 mos. regardless of miles, then every 24 mos./30,000 mi. (48,000 km) thereafter
6 - Off-the-highway operation, trailer towing, snow plowing, prolonged operation with heavy loading, especially in hot weather require more frequent transmission service.
7 - Requires Service Reminder Light. If so equipped, these parts are to be replaced at the indicated mileage or when the service reminder indicator light comes on with the key ON, whichever comes first.
8 - 5.9L only
9 - Observe the same maintenance intervals for mileage and time beyond that which appears on this chart.

AT EACH OIL CHANGE

Inspect the exhaust system.
Inspect the brake hoses.
Rotate the tires.
Check engine coolant level, hoses and clamps.
Lubricate steering linkage.
If applicable, lubricate the driveshaft universal joints and slip spline at each oil change.
After completion of off-road (4WD) operation, the underside of the vehicle should be thoroughly inspected. Examine threaded fasteners for looseness.

88471C15

MANUFACTURER RECOMMENDED MAINTENANCE INTERVALS (1994-96 HEAVY DUTY/SEVERE SERVICE)

TO BE SERVICED	TYPE OF SERVICE	VEHICLE MILEAGE INTERVAL (x1000)													
		3	6	9	12	15	18	21	24	27	30	33	36	39	miles ⑦
		5	10	14	19	24	29	34	39	43	48	53	58	63	km
Engine oil	D/R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Engine oil filter ①	R	✓ ②	✓	✓ ②	✓	✓ ②	✓	✓ ②	✓	✓ ②	✓	✓ ②	✓	✓ ②	
Front wheel bearings ③	S/I						✓			✓			✓		
Brake linings	S/I				✓				✓				✓		
Air cleaner and air pump element ④	S/I				✓				✓				✓		
Spark plugs ④	R														
Distributor cap and rotor ⑤	R														
Ignition wires ⑤	R														
PCV valve ⑤	R														
Crankcase inlet air filter	C/L								✓						
Engine coolant	F/R														
ATF / Replace filter, adjust bands	D/R				✓ ⑥				✓ ⑥				✓ ⑤		
Rear axle fluid	R				✓				✓				✓		
Front axle fluid (4x4)	R				✓				✓				✓		
Transfer case fluid	D/R												✓		

R - Replace
S/I - Service or Inspect
F/R - Flush and refill
D/R - Drain and refill

1 - If your distance travelled is less than 6000 mi. (9600 km) yearly, replace the engine oil filter at each oil change
2 - 8.0L engine only
3 - Clean and repack if required (4x2).
4 - Emission Control System Maintenance is listed in **bold type.** Service must be performed on-schedule to assure continued proper functioning of the system.
5 - Replace at 60,000 mile (96,000 km) intervals. Requires Service Reminder Light. If so equipped, these parts are to be replaced at the indicated mileage. or when the service reminder indicator light comes on with the key ON, whichever comes first.
6 - Off-the-highway operation, trailer towing, snow plowing, prolonged operation with heavy loading, especially in hot weather require more frequent transmission service.
7 - Observe the same maintenance intervals for mileage beyond that which appears on this chart.

AT EACH OIL CHANGE

Inspect the exhaust system.
Inspect the brake hoses.
Check engine coolant level, hoses and clamps.
Lubricate steering linkage.
If applicable, lubricate the driveshaft universal joints and slip spline at each oil change.
After completion of off-road (4WD) operation, the underside of the vehicle should be thoroughly inspected. Examine threaded fasteners for looseness.

AT EVERY OTHER OIL CHANGE

Rotate the tires.

88471C16

MANUFACTURER RECOMMENDED MAINTENANCE INTERVALS (1994-96 DIESEL)

TO BE SERVICED	TYPE OF SERVICE	VEHICLE MILEAGE INTERVAL (x1000)													
		6	12	18	24	30	36	42	48	54	60	66	72	78	miles ④
		10	19	29	38	48	58	67	77	86	96	106	115	125	km
		6	12	18	24	30	36	42	48	54	60	66	72	78	months
Engine oil	D/R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Engine oil filter	R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Fuel Filter	R		✓												
WP weep hole	S/I		✓		✓		✓		✓		✓		✓		
Front wheel bearings ①	S/I				✓				✓				✓		
Drive belt	S/I			✓			✓			✓			✓		
Brake linings	S/I				✓								✓		
Air cooler connections	S/I						✓						✓		
Inspect damper	S/I				✓				✓				✓		
ATF / Replace filter, adjust bands ②	D/R				✓				✓				✓		
Transfer case fluid	D/R						✓						✓		
Engine Coolant ③	F/R						✓				✓				
Valve lash clearance	A				✓				✓				✓		

WP - Water pump
R - Replace
S/I - Service or Inspect
F/R - Flush and refill
D/R - Drain and refill
A - Adjust

1 - Clean and repack if required (4x2).
2 - Off-the-highway operation, trailer towing, snow plowing, prolonged operation with heavy loading, especially in hot weather require more frequent transmission service.
3 - Flush and refill at 36 mos. regardless of miles, then every 24 mos./30,000 mi. (48,000 km) thereafter
4 - Observe the same maintenance intervals for mileage and time beyond that which appears on this chart

AT EACH OIL CHANGE

Inspect the exhaust system.
Inspect the brake hoses.
Rotate the tires.
Check engine coolant level, hoses and clamps.
Lubricate steering linkage.
After completion of off-road (4WD) operation, the underside of the vehicle should be thoroughly inspected. Examine threaded fasteners for looseness.

AT EACH STOP FOR FUEL

Check the engine oil and add as required.
Check the windshield wiper solvent and add as required.

88471C20

MANUFACTURER RECOMMENDED MAINTENANCE INTERVALS (1994-96 DIESEL - SEVERE SERVICE)

TO BE SERVICED	TYPE OF SERVICE	VEHICLE MILEAGE INTERVAL (x1000)													
		3	6	9	12	15	18	21	24	27	30	33	36	39	miles ⑤
		5	10	14	19	24	29	34	39	43	48	53	58	63	km
Engine oil	D/R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Engine oil filter	R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
WP weep hole	S/I				✓										
Front wheel bearings ①	S/I								✓						
Drive belt	S/I						✓						✓		
Brake linings	S/I				✓				✓				✓		
Air cooler connections ②	S/I				✓										
Damper	S/I														
ATF / Replace filter, adjust bands ③	D/R				✓										
Transfer case fluid	D/R								✓				✓		
Front axle fluid (4x4)	R				✓				✓				✓		
Rear axle fluid	R				✓				✓				✓		
Engine coolant ④	F/R														
Valve lash clearance	A								✓						

WP - Water pump
R - Replace
S/I - Service or Inspect
F/R - Flush and refill
D/R - Drain and refill
A - Adjust

1 - Clean and repack if required (4x2).
2 - Or at 12 month intervals.
3 - Off-the-highway operation, trailer towing, snow plowing, prolonged operation with heavy loading, especially in hot weather require more frequent transmission service.
4 - Flush and refill at 36 mos. regardless of miles, then every 24 mos./30,000 mi. (48,000 km) thereafter
5 - Observe the same maintenance intervals for mileage beyond that which appears on this chart

AT EACH OIL CHANGE

Inspect the exhaust system.
Inspect the brake hoses.
Check engine coolant level, hoses and clamps.
Lubricate steering linkage.
After completion of off-road (4WD) operation, the underside of the vehicle should be thoroughly inspected. Examine threaded fasteners for looseness.

AT EVERY OTHER OIL CHANGE

Rotate the tires.

AT EACH STOP FOR FUEL

Check the engine oil and add as required.
Check the windshield wiper solvent and add as required

88471C21

CAPACITIES

Year	Model	Engine ID/VIN	Engine Displacement Liters (cc)	Engine Oil with Filter (qts.)	Transmission (pts.)			Transfer Case (pts.)	Drive Axle		Fuel Tank (gal.)	Cooling System (qts.)
					4-Spd	5-Spd	Auto.		Front (pts.)	Rear (pts.)		
1989	D/W 150 Pick-up	X	3.9 (3916)	4.5	7.0	4.0	[1]	[5]	[10]	[2]	22.0 [3]	15.1
	D/W 150 Pick-up	Y	5.2 (5211)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	22.0 [3]	17.0
	D/W 150 Pick-up	W	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5 [4]
	D/W 150 Pick-up	Z	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5
	D250 Pick-up	X	3.9 (3916)	4.5	7.0	4.0	[1]	-	-	[2]	22.0 [3]	15.1
	D/W 250 Pick-up	Y	5.2 (5211)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	22.0 [3]	17.0
	D/W 250 Pick-up	8	5.9 (5882)	12.0	-	7.0	22.0	4.5	6.3	7.0	30.0	[9]
	D/W 250 Pick-up	W	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5 [4]
	D/W 250 Pick-up	Z	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5
	D/W 350 Pick-up	8	5.9 (5882)	12.0	-	7.0	22.0		6.3	7.0	30.0	[9]
	D/W 350 Pick-up	W	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5 [4]
	D/W 350 Pick-up	Z	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5
	Ramcharger	Y	5.2 (5211)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	34.0	17.0
	Ramcharger	W	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	34.0	15.5
	Ramcharger	Z	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	34.0	15.5
	Dakota	K	2.5 (2507)	4.0	-	4.0	15.6	4.5	2.6	[6]	15.0 [7]	9.8
	Dakota	X	3.9 (3916)	4.0	-	4.0	17.2	4.5	2.6	[6]	15.0 [7]	14.0
1990	D/W 150 Pick-up	X	3.9 (3916)	4.0	7.0	4.0	[1]	[5]	[10]	[2]	22.0 [3]	15.1
	D/W 150 Pick-up	Y	5.2 (5211)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	22.0 [3]	17.0
	D/W 150 Pick-up	Z	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5
	D250 Pick-up	X	3.9 (3916)	4.0	7.0	4.0	[1]	-	-	[2]	22.0 [3]	15.1
	D/W 250 Pick-up	Y	5.2 (5211)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	22.0 [3]	17.0
	D/W 250 Pick-up	8	5.9 (5882)	12.0	-	7.0	22.0	[5]	6.5	[2]	30.0	[9]
	D/W 250 Pick-up	Z	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5
	D/W 350 Pick-up	8	5.9 (5882)	12.0	-	7.0	22.0	[5]	6.5	[2]	30.0	[9]
	D/W 350 Pick-up	Z	5.9 (5899)	5.0	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5
	Ramcharger	Y	5.2 (5211)	5.0	7.0	4.0	17.2	[5]	[10]	[2]	34.0	16.5
	Ramcharger	5	5.9 (5899)	5.0	7.0	4.0	16.8	[5]	[10]	[2]	34.0	15.0
	Ramcharger	Z	5.9 (5899)	5.0	7.0	4.0	16.8	[5]	[10]	[2]	34.0	15.0
	Dakota	K	2.5 (2507)	4.0	-	4.0	20.4	2.5	2.6	[10]	15.0 [7]	9.8
	Dakota	X	3.9 (3916)	4.0	-	4.0	20.4	2.5	2.6	[10]	15.0 [7]	14.0
1991	D/W 150 Pick-up	X	3.9 (3916)	4.5	7.0	4.0	[1]	[5]	[10]	[2]	22.0 [3]	15.1
	D/W 150 Pick-up	Y	5.2 (5211)	4.5	7.0	4.0	[1]	[5]	[10]	[2]	22.0 [3]	17.0
	D/W 150 Pick-up	Z	5.9 (5899)	4.5	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5
	D250 Pick-up	X	3.9 (3916)	4.5	7.0	4.0	[1]	-	-	[2]	22.0 [3]	15.1
	D/W 250 Pick-up	Y	5.2 (5211)	4.5	7.0	4.0	[1]	[5]	[10]	[2]	22.0 [3]	15.5
	D/W 250 Pick-up	8	5.9 (5882)	12.5	-	7.0	22.0	[5]	6.5	14.0	30.0	18.0
	D/W 250 Pick-up	Z	5.9 (5899)	4.5	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5
	D/W 350 Pick-up	8	5.9 (5882)	12.5	-	7.0	22.0	[5]	6.5	14.0	30.0	18.0
	D/W 350 Pick-up	5	5.9 (5899)	4.5	7.0	4.0	[1]	[5]	[10]	[2]	30.0	15.5
	Ramcharger	Y	5.2 (5211)	4.5	7.0	4.0	[1]	[5]	[10]	[2]	34.0	16.5
	Ramcharger	Z	5.9 (5899)	4.5	7.0	4.0	[1]	[5]	[10]	[2]	34.0	15.0
	Dakota	K	2.5 (2507)	4.5	-	4.0	10.4	5.0	2.6	[6]	15.0 [7]	9.8
	Dakota	X	3.9 (3916)	4.5	-	4.0	10.4	5.0	2.6	[6]	15.0 [7]	14.0
	Dakota	Y	5.2 (5211)	4.5	-	4.0	10.4	5.0	2.6	[6]	15.0 [7]	14.3

88471C07

CAPACITIES

Year	Model	Engine ID/VIN	Engine Displacement Liters (cc)	Engine Oil with Filter (qts.)	Transmission (pts.)			Transfer Case (pts.)	Drive Axle		Fuel Tank (gal.)	Cooling System (qts.)
					4-Spd	5-Spd	Auto.		Front (pts.)	Rear (pts.)		
1992	D/W 150 Pick-up	X	3.9 (3916)	4.5	-	8.0	[1]	[5]	[10]	[2]	22.0 [3]	15.1
	D/W 150 Pick-up	Y	5.2 (5211)	4.5	-	8.0	[1]	[5]	[10]	[2]	22.0 [3]	17.0
	D/W 150 Pick-up	Z	5.9 (5899)	4.5	-	8.0	[1]	[5]	[10]	[2]	30.0	15.5
	D 250 Pick-up	X	3.9 (3916)	4.5	-	8.0	[1]	-	[10]	[2]	22.0 [3]	15.1
	D/W 250 Pick-up	Y	5.2 (5211)	4.5	-	8.0	[1]	[5]	[10]	[2]	22.0 [3]	17.0
	D/W 250 Pick-up	8	5.9 (5882)	12.5	-	7.0	22.0	[5]	6.5	[2]	30.0	[9]
	D/W 250 Pick-up	Z	5.9 (5899)	4.5	-	8.0	[1]	[5]	[10]	[2]	30.0	15.5
	D/W 350 Pick-up	8	5.9 (5882)	12.5	-	7.0	22.0	[5]	6.5	[2]	30.0	[9]
	D/W 350 Pick-up	5	5.9 (5899)	4.5	-	8.0	[1]	[5]	[10]	[2]	30.0	15.5
	Ramcharger	Y	5.2 (5211)	4.5	-	8.0	[1]	[5]	[10]	[2]	34.0	17.0
	Ramcharger	Z	5.9 (5899)	4.5	-	8.0	[1]	[5]	[10]	[2]	34.0	15.5
	Dakota	K	2.5 (2507)	4.5	-	4.0	10.4	2.5	2.6	[10]	15.0 [7]	9.5
	Dakota	X	3.9 (3916)	4.5	-	6.6	10.4	2.5	2.6	[10]	15.0 [7]	14.0
	Dakota	Y	5.2 (5211)	4.5	-	6.6	10.4	2.5	2.6	[10]	15.0 [7]	14.3
1993	D/W 150 Pick-up	X	3.9 (3916)	4.5	-	8.0	[1]	[5]	[10]	[2]	22.0 [3]	15.1
	D/W 150 Pick-up	Y	5.2 (5211)	4.5	-	8.0	[1]	[5]	[10]	[2]	22.0 [3]	17.0
	D/W 150 Pick-up	Z	5.9 (5899)	4.5	-	8.0	[1]	[5]	[10]	[2]	30.0	15.5
	D250 Pick-up	X	3.9 (3916)	4.5	-	8.0	[1]	-	[10]	[2]	22.0 [3]	15.1
	D/W 250 Pick-up	Y	5.2 (5211)	4.5	-	8.0	[1]	[5]	[10]	[2]	22.0 [3]	17.0
	D/W 250 Pick-up	8	5.9 (5882)	12.5	-	7.0	22.0	[5]	6.5	[2]	30.0	[9]
	D/W 250 Pick-up	Z	5.9 (5899)	4.5	-	8.0	[1]	[5]	[10]	[2]	30.0	15.5
	D/W 350 Pick-up	8	5.9 (5882)	12.5	-	7.0	22.0	[5]	6.5	[2]	30.0	[9]
	D/W 350 Pick-up	5	5.9 (5899)	4.5	-	8.0	[1]	[5]	[10]	[2]	30.0	15.5
	Ramcharger	Y	5.2 (5211)	4.5	-	8.0	[1]	[5]	[10]	[2]	34.0	17.0
	Ramcharger	Z	5.9 (5899)	4.5	-	8.0	[1]	[5]	[10]	[2]	34.0	15.5
	Dakota	K	2.5 (2507)	4.5	-	6.6	10.4	4.5	2.6	[6]	15.0 [7]	9.8
	Dakota	X	3.9 (3916)	4.5	-	6.6	10.4	4.5	2.6	[6]	15.0 [7]	14.0
	Dakota	Y	5.2 (5211)	5.0	-	6.6	10.4	4.5	2.6	[6]	15.0 [7]	14.3
1994	D 1500 Pick-up	X	3.9 (3916)	4.0	-	[11]	[12]	-	-	[14]	26.0 [15]	20.0
	D/W 1500 Pick-up	Y	5.2 (5211)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 1500 Pick-up	Z	5.9 (5899)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 2500 Pick-up	Y	5.2 (5211)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 2500 Pick-up	C	5.9 (5882)	11.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	26.0
	D/W 2500 Pick-up	Z	5.9 (5899)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 2500 Pick-up	W	8.0 (7997)	7.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	24.0
	D/W 3500 Pick-up	C	5.9 (5882)	11.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	26.0
	D/W 3500 Pick-up	5	5.9 (5899)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 3500 Pick-up	W	8.0 (7997)	7.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	24.0
	Dakota	K	2.5 (2507)	4.5	-	[11]	[12]	2.5	3.0	[6]	15.0 [7]	9.8
	Dakota	X	3.9 (3916)	4.5	-	[11]	[12]	2.5	3.0	[6]	15.0 [7]	14.0
	Dakota	Y	5.2 (5211)	5.0	-	[11]	[12]	2.5	3.0	[6]	15.0 [7]	14.3

88471C08

CAPACITIES

Year	Model	Engine ID/VIN	Engine Displacement Liters (cc)	Engine Oil with Filter (qts.)	Transmission (pts.)			Transfer Case (pts.)	Drive Axle		Fuel Tank (gal.)	Cooling System (qts.)
					4-Spd	5-Spd	Auto.		Front (pts.)	Rear (pts.)		
1995	D 1500 Pick-up	X	3.9 (3916)	4.0	-	[11]	[12]	-	-	[14]	26.0 [15]	20.0
	D/W 1500 Pick-up	Y	5.2 (5211)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 1500 Pick-up	Z	5.9 (5899)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 2500 Pick-up	Y	5.2 (5211)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 2500 Pick-up	C	5.9 (5882)	11.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	26.0
	D/W 2500 Pick-up	Z	5.9 (5899)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 2500 Pick-up	W	8.0 (7997)	7.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	24.0
	D/W 3500 Pick-up	C	5.9 (5882)	11.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	26.0
	D/W 3500 Pick-up	5	5.9 (5899)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 3500 Pick-up	W	8.0 (7997)	7.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	24.0
	Dakota	K	2.5 (2507)	4.5	-	[11]	[12]	2.5	3.0	[6]	15.0 [7]	9.8
	Dakota	X	3.9 (3916)	4.5	-	[11]	[12]	2.5	3.0	[6]	15.0 [7]	14.0
	Dakota	Y	5.2 (5211)	5.0	-	[11]	[12]	2.5	3.0	[6]	15.0 [7]	14.3
1996	D 1500 Pick-up	X	3.9 (3916)	4.0	-	[11]	[12]	-	-	[14]	26.0 [15]	20.0
	D/W 1500 Pick-up	Y	5.2 (5211)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 1500 Pick-up	Z	5.9 (5899)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 2500 Pick-up	Y	5.2 (5211)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 2500 Pick-up	C	5.9 (5882)	11.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	26.0
	D/W 2500 Pick-up	Z	5.9 (5899)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 2500 Pick-up	W	8.0 (7997)	7.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	24.0
	D/W 3500 Pick-up	C	5.9 (5882)	11.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	26.0
	D/W 3500 Pick-up	5	5.9 (5899)	5.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	20.0
	D/W 3500 Pick-up	W	8.0 (7997)	7.0	-	[11]	[12]	[13]	[10]	[14]	26.0 [15]	24.0
	Dakota	K	2.5 (2507)	4.5	-	[11]	[12]	2.5	3.0	[6]	15.0 [7]	9.8
	Dakota	X	3.9 (3916)	4.5	-	[11]	[12]	2.5	3.0	[6]	15.0 [7]	14.0
	Dakota	Y	5.2 (5211)	5.0	-	[11]	[12]	2.5	3.0	[6]	15.0 [7]	14.3

[1] A904/A998/A999 and A727: 17.1 pts.
A500: 20.4 pts.

[2] Chrysler 8.25 in and 9.25 in.: 4.5 pts.
Spicer/Dana 60: 6.0 pts.; Spicer/Dana 70: 7.0 pts.

[3] Optional fuel tank: 30 gals.

[4] With HD cooling or A/C, add one quart

[5] NP205: 4.5 pts.; NP241: 6.0 pts.

[6] With 7.25 in. rear: 3.0 pts.
With 8.25 in. rear: 4.4 pts.

[7] Optional fuel tank: 22 gals.

[8] Conventional rear: 5.5 pts.
Limited slip rear: 5.5 pts.

[9] Automatic transmission: 16.5 qts.
Manual transmission: 15.5 qts.

[10] Spicer 44FBJ/FBT: 5.6 pts.
Spicer 60: 6.5 pts.
7.25 in.: 3 pts.

[11] NV3500: 4.2 pts.
NV4500: 8 pts.
AX15: 6.6 pts.
Getraq: 7 pts.

[12] 32RH: 17 pts.
36RH: 16.6 pts.
42RH: 20.2 pts.
46RH: 21.8 pts.
47RH: 30.8 pts.

[13] NP231HD: 2.5 pts.
NP241: 4.7 pts.
NP241HD: 13 pts.

[14] Chrysler 7.25 in.: 3 pts.
Chrysler 8.25 in. and 9.25 in.: 4.8 pts.
Spicer and Dana 60: 6.0 pts.
Dana 70 and 80: 7.0 pts.

[15] Optional fuel tank: 35 gals.

88471C09

ENGLISH TO METRIC CONVERSION: MASS (WEIGHT)

Current mass measurement is expressed in pounds and ounces (lbs. & ozs.). The metric unit of mass (or weight) is the kilogram (kg). Even although this table does not show conversion of masses (weights) larger than 15 lbs, it is easy to calculate larger units by following the data immediately below.

To convert ounces (oz.) to grams (g): multiply th number of ozs. by 28
To convert grams (g) to ounces (oz.): multiply the number of grams by .035

To convert pounds (lbs.) to kilograms (kg): multiply the number of lbs. by .45
To convert kilograms (kg) to pounds (lbs.): multiply the number of kilograms by 2.2

lbs	kg	lbs	kg	oz	kg	oz	kg
0.1	0.04	0.9	0.41	0.1	0.003	0.9	0.024
0.2	0.09	1	0.4	0.2	0.005	1	0.03
0.3	0.14	2	0.9	0.3	0.008	2	0.06
0.4	0.18	3	1.4	0.4	0.011	3	0.08
0.5	0.23	4	1.8	0.5	0.014	4	0.11
0.6	0.27	5	2.3	0.6	0.017	5	0.14
0.7	0.32	10	4.5	0.7	0.020	10	0.28
0.8	0.36	15	6.8	0.8	0.023	15	0.42

ENGLISH TO METRIC CONVERSION: TEMPERATURE

To convert Fahrenheit (°F) to Celsius (°C): take number of °F and subtract 32; multiply result by 5; divide result by 9

To convert Celsius (°C) to Fahrenheit (°F): take number of °C and multiply by 9; divide result by 5; add 32 to total

Fahrenheit (F)		Celsius (C)		Fahrenheit (F)		Celsius (C)		Fahrenheit (F)		Celsius (C)	
°F	°C	°C	°F	°F	°C	°C	°F	°F	°C	°C	°F
−40	−40	−38	−36.4	80	26.7	18	64.4	215	101.7	80	176
−35	−37.2	−36	−32.8	85	29.4	20	68	220	104.4	85	185
−30	−34.4	−34	−29.2	90	32.2	22	71.6	225	107.2	90	194
−25	−31.7	−32	−25.6	95	35.0	24	75.2	230	110.0	95	202
−20	−28.9	−30	−22	100	37.8	26	78.8	235	112.8	100	212
−15	−26.1	−28	−18.4	105	40.6	28	82.4	240	115.6	105	221
−10	−23.3	−26	−14.8	110	43.3	30	86	245	118.3	110	230
−5	−20.6	−24	−11.2	115	46.1	32	89.6	250	121.1	115	239
0	−17.8	−22	−7.6	120	48.9	34	93.2	255	123.9	120	248
1	−17.2	−20	−4	125	51.7	36	96.8	260	126.6	125	257
2	−16.7	−18	−0.4	130	54.4	38	100.4	265	129.4	130	266
3	−16.1	−16	3.2	135	57.2	40	104	270	132.2	135	275
4	−15.6	−14	6.8	140	60.0	42	107.6	275	135.0	140	284
5	−15.0	−12	10.4	145	62.8	44	112.2	280	137.8	145	293
10	−12.2	−10	14	150	65.6	46	114.8	285	140.6	150	302
15	−9.4	−8	17.6	155	68.3	48	118.4	290	143.3	155	311
20	−6.7	−6	21.2	160	71.1	50	122	295	146.1	160	320
25	−3.9	−4	24.8	165	73.9	52	125.6	300	148.9	165	329
30	−1.1	−2	28.4	170	76.7	54	129.2	305	151.7	170	338
35	1.7	0	32	175	79.4	56	132.8	310	154.4	175	347
40	4.4	2	35.6	180	82.2	58	136.4	315	157.2	180	356
45	7.2	4	39.2	185	85.0	60	140	320	160.0	185	365
50	10.0	6	42.8	190	87.8	62	143.6	325	162.8	190	374
55	12.8	8	46.4	195	90.6	64	147.2	330	165.6	195	383
60	15.6	10	50	200	93.3	66	150.8	335	168.3	200	392
65	18.3	12	53.6	205	96.1	68	154.4	340	171.1	205	401
70	21.1	14	57.2	210	98.9	70	158	345	173.9	210	410
75	23.9	16	60.8	212	100.0	75	167	350	176.7	215	414

TCCS1C01

ENGLISH TO METRIC CONVERSION: LENGTH

To convert inches (ins.) to millimeters (mm): multiply number of inches by 25.4

To convert millimeters (mm) to inches (ins.): multiply number of millimeters by .04

Inches	Decimals	Milli-meters	Inches to millimeters		Inches	Decimals	Milli-meters	Inches to millimeters	
			inches	mm				inches	mm
1/64	0.051625	0.3969	0.0001	0.00254	33/64	0.515625	13.0969	0.6	15.24
1/32	0.03125	0.7937	0.0002	0.00508	17/32	0.53125	13.4937	0.7	17.78
3/64	0.046875	1.1906	0.0003	0.00762	35/64	0.546875	13.8906	0.8	20.32
1/16	0.0625	1.5875	0.0004	0.01016	9/16	0.5625	14.2875	0.9	22.86
5/64	0.078125	1.9844	0.0005	0.01270	37/64	0.578125	14.6844	1	25.4
3/32	0.09375	2.3812	0.0006	0.01524	19/32	0.59375	15.0812	2	50.8
7/64	0.109375	2.7781	0.0007	0.01778	39/64	0.609375	15.4781	3	76.2
1/8	0.125	3.1750	0.0008	0.02032	5/8	0.625	15.8750	4	101.6
9/64	0.140625	3.5719	0.0009	0.02286	41/64	0.640625	16.2719	5	127.0
5/32	0.15625	3.9687	0.001	0.0254	21/32	0.65625	16.6687	6	152.4
11/64	0.171875	4.3656	0.002	0.0508	43/64	0.671875	17.0656	7	177.8
3/16	0.1875	4.7625	0.003	0.0762	11/16	0.6875	17.4625	8	203.2
13/64	0.203125	5.1594	0.004	0.1016	45/64	0.703125	17.8594	9	228.6
7/32	0.21875	5.5562	0.005	0.1270	23/32	0.71875	18.2562	10	254.0
15/64	0.234375	5.9531	0.006	0.1524	47/64	0.734375	18.6531	11	279.4
1/4	0.25	6.3500	0.007	0.1778	3/4	0.75	19.0500	12	304.8
17/64	0.265625	6.7469	0.008	0.2032	49/64	0.765625	19.4469	13	330.2
9/32	0.28125	7.1437	0.009	0.2286	25/32	0.78125	19.8437	14	355.6
19/64	0.296875	7.5406	0.01	0.254	51/64	0.796875	20.2406	15	381.0
5/16	0.3125	7.9375	0.02	0.508	13/16	0.8125	20.6375	16	406.4
21/64	0.328125	8.3344	0.03	0.762	53/64	0.828125	21.0344	17	431.8
11/32	0.34375	8.7312	0.04	1.016	27/32	0.84375	21.4312	18	457.2
23/64	0.359375	9.1281	0.05	1.270	55/64	0.859375	21.8281	19	482.6
3/8	0.375	9.5250	0.06	1.524	7/8	0.875	22.2250	20	508.0
25/64	0.390625	9.9219	0.07	1.778	57/64	0.890625	22.6219	21	533.4
13/32	0.40625	10.3187	0.08	2.032	29/32	0.90625	23.0187	22	558.8
27/64	0.421875	10.7156	0.09	2.286	59/64	0.921875	23.4156	23	584.2
7/16	0.4375	11.1125	0.1	2.54	15/16	0.9375	23.8125	24	609.6
29/64	0.453125	11.5094	0.2	5.08	61/64	0.953125	24.2094	25	635.0
15/32	0.46875	11.9062	0.3	7.62	31/32	0.96875	24.6062	26	660.4
31/64	0.484375	12.3031	0.4	10.16	63/64	0.984375	25.0031	27	690.6
1/2	0.5	12.7000	0.5	12.70					

ENGLISH TO METRIC CONVERSION: TORQUE

To convert foot-pounds (ft. lbs.) to Newton-meters: multiply the number of ft. lbs. by 1.3

To convert inch-pounds (in. lbs.) to Newton-meters: multiply the number of in. lbs. by .11

in lbs	N-m	in lbs	N-m	in lbs	N-m	in lbs	N-m	in lbs	N-m
0.1	0.01	1	0.11	10	1.13	19	2.15	28	3.16
0.2	0.02	2	0.23	11	1.24	20	2.26	29	3.28
0.3	0.03	3	0.34	12	1.36	21	2.37	30	3.39
0.4	0.04	4	0.45	13	1.47	22	2.49	31	3.50
0.5	0.06	5	0.56	14	1.58	23	2.60	32	3.62
0.6	0.07	6	0.68	15	1.70	24	2.71	33	3.73
0.7	0.08	7	0.78	16	1.81	25	2.82	34	3.84
0.8	0.09	8	0.90	17	1.92	26	2.94	35	3.95
0.9	0.10	9	1.02	18	2.03	27	3.05	36	4.0

TCCS1C02

ENGLISH TO METRIC CONVERSION: TORQUE

Torque is now expressed as either foot-pounds (ft./lbs.) or inch-pounds (in./lbs.). The metric measurement unit for torque is the Newton-meter (Nm). This unit—the Nm—will be used for all SI metric torque references, both the present ft./lbs. and in./lbs.

ft lbs	N-m	ft lbs	N-m	ft lbs	N-m	ft lbs	N-m
0.1	0.1	33	44.7	74	100.3	115	155.9
0.2	0.3	34	46.1	75	101.7	116	157.3
0.3	0.4	35	47.4	76	103.0	117	158.6
0.4	0.5	36	48.8	77	104.4	118	160.0
0.5	0.7	37	50.7	78	105.8	119	161.3
0.6	0.8	38	51.5	79	107.1	120	162.7
0.7	1.0	39	52.9	80	108.5	121	164.0
0.8	1.1	40	54.2	81	109.8	122	165.4
0.9	1.2	41	55.6	82	111.2	123	166.8
1	1.3	42	56.9	83	112.5	124	168.1
2	2.7	43	58.3	84	113.9	125	169.5
3	4.1	44	59.7	85	115.2	126	170.8
4	5.4	45	61.0	86	116.6	127	172.2
5	6.8	46	62.4	87	118.0	128	173.5
6	8.1	47	63.7	88	119.3	129	174.9
7	9.5	48	65.1	89	120.7	130	176.2
8	10.8	49	66.4	90	122.0	131	177.6
9	12.2	50	67.8	91	123.4	132	179.0
10	13.6	51	69.2	92	124.7	133	180.3
11	14.9	52	70.5	93	126.1	134	181.7
12	16.3	53	71.9	94	127.4	135	183.0
13	17.6	54	73.2	95	128.8	136	184.4
14	18.9	55	74.6	96	130.2	137	185.7
15	20.3	56	75.9	97	131.5	138	187.1
16	21.7	57	77.3	98	132.9	139	188.5
17	23.0	58	78.6	99	134.2	140	189.8
18	24.4	59	80.0	100	135.6	141	191.2
19	25.8	60	81.4	101	136.9	142	192.5
20	27.1	61	82.7	102	138.3	143	193.9
21	28.5	62	84.1	103	139.6	144	195.2
22	29.8	63	85.4	104	141.0	145	196.6
23	31.2	64	86.8	105	142.4	146	198.0
24	32.5	65	88.1	106	143.7	147	199.3
25	33.9	66	89.5	107	145.1	148	200.7
26	35.2	67	90.8	108	146.4	149	202.0
27	36.6	68	92.2	109	147.8	150	203.4
28	38.0	69	93.6	110	149.1	151	204.7
29	39.3	70	94.9	111	150.5	152	206.1
30	40.7	71	96.3	112	151.8	153	207.4
31	42.0	72	97.6	113	153.2	154	208.8
32	43.4	73	99.0	114	154.6	155	210.2

TCCS1C03

ENGLISH TO METRIC CONVERSION: FORCE

Force is presently measured in pounds (lbs.). This type of measurement is used to measure spring pressure, specifically how many pounds it takes to compress a spring. Our present force unit (the pound) will be replaced in SI metric measurements by the Newton (N). This term will eventually see use in specifications for electric motor brush spring pressures, valve spring pressures, etc.

To convert pounds (lbs.) to Newton (N): multiply the number of lbs. by 4.45

lbs	N	lbs	N	lbs	N	oz	N
0.01	0.04	21	93.4	59	262.4	1	0.3
0.02	0.09	22	97.9	60	266.9	2	0.6
0.03	0.13	23	102.3	61	271.3	3	0.8
0.04	0.18	24	106.8	62	275.8	4	1.1
0.05	0.22	25	111.2	63	280.2	5	1.4
0.06	0.27	26	115.6	64	284.6	6	1.7
0.07	0.31	27	120.1	65	289.1	7	2.0
0.08	0.36	28	124.6	66	293.6	8	2.2
0.09	0.40	29	129.0	67	298.0	9	2.5
0.1	0.4	30	133.4	68	302.5	10	2.8
0.2	0.9	31	137.9	69	306.9	11	3.1
0.3	1.3	32	142.3	70	311.4	12	3.3
0.4	1.8	33	146.8	71	315.8	13	3.6
0.5	2.2	34	151.2	72	320.3	14	3.9
0.6	2.7	35	155.7	73	324.7	15	4.2
0.7	3.1	36	160.1	74	329.2	16	4.4
0.8	3.6	37	164.6	75	333.6	17	4.7
0.9	4.0	38	169.0	76	338.1	18	5.0
1	4.4	39	173.5	77	342.5	19	5.3
2	8.9	40	177.9	78	347.0	20	5.6
3	13.4	41	182.4	79	351.4	21	5.8
4	17.8	42	186.8	80	355.9	22	6.1
5	22.2	43	191.3	81	360.3	23	6.4
6	26.7	44	195.7	82	364.8	24	6.7
7	31.1	45	200.2	83	369.2	25	7.0
8	35.6	46	204.6	84	373.6	26	7.2
9	40.0	47	209.1	85	378.1	27	7.5
10	44.5	48	213.5	86	382.6	28	7.8
11	48.9	49	218.0	87	387.0	29	8.1
12	53.4	50	224.4	88	391.4	30	8.3
13	57.8	51	226.9	89	395.9	31	8.6
14	62.3	52	231.3	90	400.3	32	8.9
15	66.7	53	235.8	91	404.8	33	9.2
16	71.2	54	240.2	92	409.2	34	9.4
17	75.6	55	244.6	93	413.7	35	9.7
18	80.1	56	249.1	94	418.1	36	10.0
19	84.5	57	253.6	95	422.6	37	10.3
20	89.0	58	258.0	96	427.0	38	10.6

TCCS1C04

2

ENGINE ELECTRICAL

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ELECTRONIC DISTRIBUTOR IGNITION SYSTEM

General Information

➧ See Figures 1, 2 and 3

The electronic distributor ignition system is found on all 2.5L, 3.9L, 5.2L, 5.9L Light Duty Cycle (LDC) and 5.9L Heavy Duty Cycle (HDC) engines. Therefore, unless otherwise noted, the procedures in this section pertain to all engines. The only engine which does not make use of the electronic distributor ignition system, the V10 HDC engine, is covered under "Distributorless Ignition Systems."

The engine controller is an on-board digital computer which automatically advances or retards the spark to fire the spark plugs according to different engine operating conditions. It has a built in microprocessor which continually receives input from various engine sensors. Input data is fed to the computer by a the sensors located in the engine compartment. These sensors monitor timing, water temperature, air temperature, idle/off-idle operation and intake manifold vacuum. The program schedule module of the engine controller receives the information from the sensors, processes it, then directs the ignition control module to advance or retard the timing as necessary. This whole process goes on continuously as the engine is running, taking only milliseconds to complete a circuit from sensor to distributor.

Although, for the models covered by this manual, the engine controller performs essentially the same function, it has over the years been called a few different names. In 1989 models, the manufacturer called it the Single Module Engine Controller (SMEC); for 1990-91 models it was called the Single Board Engine Controller (SBEC); for 1992 it was simply known as the Engine Controller, and since 1993 it is called the Powertrain Control Module (PCM). The unit is found in the engine compartment mounted to the left or right side inner fender or the firewall.

Diagnosis and Testing

This group of procedures are basic tests of the secondary circuit. For information on the various sensors that supply data to the PCM, please refer to the index at the beginning of this section for assistance.

CHECKING FOR SPARK

➧ See Figures 4, 5 and 6

➡The coil design was changed in 1993, but its function is the same. Therefore the test for all covered models is the same.

✲✲ WARNING

Do not attempt to pull the wire from the distributor cap of the 2.5L engine. The cap must be removed and the wire released from inside the cap.

1. Remove the coil wire from the distributor cap with an insulated spark plug puller tool. Using the insulated tool, hold the wire end cautiously about ½ in. (12mm) away from an engine ground. Use a remote starter switch or have an assistant crank the engine while checking for spark.
2. If a good spark (steady arcing of current) is not present, inspect the secondary coil wire.
3. If a good spark is seen, connect the wire to the distributor cap.
4. Remove the wire from one spark plug by grasping the rubber boot and twisting slightly as you pull, or use spark plug pliers.
5. Using insulated pliers, hold the wire about ½ in. (12mm) away from a

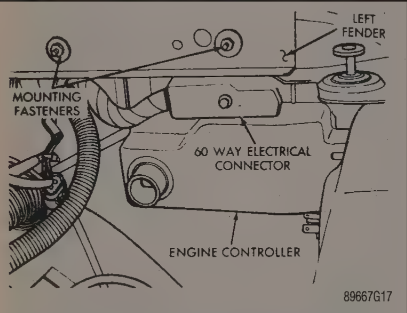

LEFT FENDER
MOUNTING FASTENERS
60 WAY ELECTRICAL CONNECTOR
ENGINE CONTROLLER
89667G17

Fig. 1 The engine controller is a computer with a digital microprocessor that regulates the ignition operation—1991 Ram unit shown, others similar

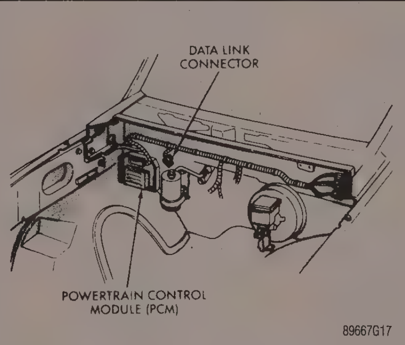

DATA LINK CONNECTOR
POWERTRAIN CONTROL MODULE (PCM)
89667G17

Fig. 2 Engine controller mounted to the firewall—1995 Ram shown, others similar

Fig. 3 Here the PCM (engine controller) is found against the firewall—note the heavy wire harness attached to it

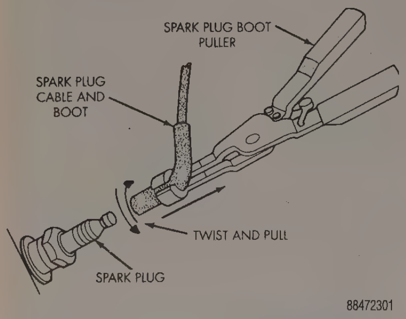

SPARK PLUG BOOT PULLER
SPARK PLUG CABLE AND BOOT
TWIST AND PULL
SPARK PLUG
88472301

Fig. 4 Use a spark plug boot puller tool to reduce the chances of stressing the crimp at the wire and connector

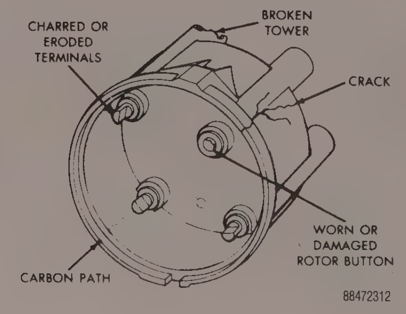

CHARRED OR ERODED TERMINALS
BROKEN TOWER
CRACK
WORN OR DAMAGED ROTOR BUTTON
CARBON PATH
88472312

Fig. 5 Check the distributor cap for these conditions—replace if any are present

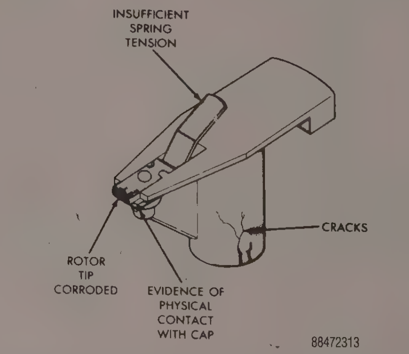

INSUFFICIENT SPRING TENSION
CRACKS
ROTOR TIP CORRODED
EVIDENCE OF PHYSICAL CONTACT WITH CAP
88472313

Fig. 6 Inspect the rotor for any of the damage shown and replace if damage is found

good engine ground and test for spark as you did previously. Be careful of the spark that should occur.

➡The ignition coil wire should deliver a stronger, brighter spark than the spark plug wires. A somewhat lesser, duller spark at the spark plugs is a normal condition.

6. If a good spark occurs, you are safe in assuming the ignition secondary system is operating correctly. If the engine does not start, proceed to the "Failure-To-Start" test.
7. If no spark was found, inspect the distributor cap, rotor and wires.

FAILURE-TO-START TEST

➧ See Figures 7, 8 and 9

The "Checking For Spark" test should be performed prior to this test.

This is a basic test of the ignition system that systematically examines the battery, the coil, the engine controller, and its wiring harness and connections; the most likely culprits in a no-start condition at this stage.

1. Unplug the ignition coil harness connector at the coil.
2. Connect a set of small jumper wires (18 gauge or smaller) between the disconnected harness terminals and the ignition coil terminals.
3. Attach one lead of a voltmeter to the positive (12V) jumper wire. Attach the negative side of the voltmeter to a good ground. Measure the voltage at the battery and confirm that enough current is available to operate the starting and ignition systems.
4. Crank the engine for five seconds while monitoring the voltage at the coil positive terminal:
    a. If the voltage remains at zero, diagnosis of the fuel system should be performed. Also check the engine controller and auto shutdown relay.
    b. If voltage is at or near battery voltage and then drops to zero after one or two seconds of engine cranking, check the engine control module circuit.

✲✲ WARNING

The ignition must be turned OFF prior to unplugging the engine controller connector. If it is not, electrical surging could occur causing damage to the unit or other electrical components in the vehicle.

    c. If the voltage remains at or near battery voltage during the entire five seconds, turn the ignition key OFF. Remove the 14-way connector on 1989 models, or the 60-way connector on 1990-96 models at the engine controller. Check the 14-way or 60-way connector for any spread terminals.
5. Remove the test lead from the coil positive terminal. Connect an 18 gauge jumper wire between the battery positive terminal and the coil positive terminal.
6. Make a special jumper cable (see illustration). Using the jumper MOMENTARILY ground terminal 12 on the 14-way connector (1989), or terminal 19 (see illustration) of the 1990-96 60-way connector. A spark should be generated at the coil wire when the ground is removed.
    a. If a spark is generated, replace the engine controller computer.
    b. If no spark is seen, use the special jumper to ground the coil negative terminal directly. If spark is produced, repair the wiring harness for an open circuit condition. If spark is not produced, replace the ignition coil.

Ignition Coil

TESTING

➧ See Figures 10, 11, 12 and 13

The ignition coil should be tested with a special ignition coil tester, such as the Chrysler DRB scan tool, or equivalent. For basic function tests please refer to the "Checking For Spark" test and the "Failure-To-Start Test." This procedure is to determine whether an operating coil may be below specification, or in some way faulty.

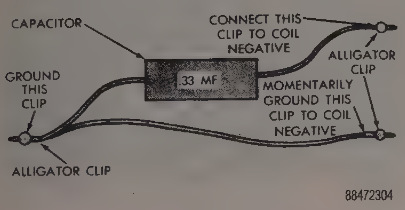

CAPACITOR
CONNECT THIS CLIP TO COIL NEGATIVE
ALLIGATOR CLIP
GROUND THIS CLIP
.33 MF
MOMENTARILY GROUND THIS CLIP TO COIL NEGATIVE
ALLIGATOR CLIP
88472304

Fig. 7 Fabricate this special jumper with a 0.33 MF capacitor in-line to test the ignition coil

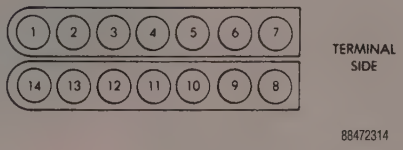

1
2
3
4
5
6
7
14
13
12
11
10
9
8
TERMINAL SIDE
88472314

Fig. 8 Terminal locations on the engine controller 14-way connector—1989 models

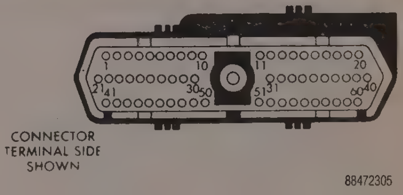

1
10
11
20
21
30
31
40
41
50
51
60
CONNECTOR TERMINAL SIDE SHOWN
88472305

Fig. 9 Engine controller 60-way connector—relevant terminals for testing are shown numbered

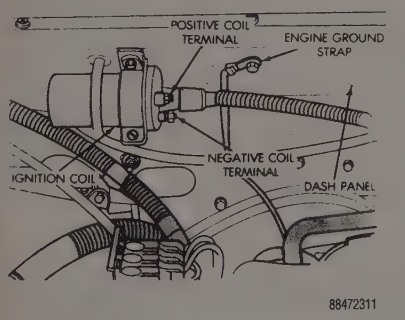

POSITIVE COIL TERMINAL
ENGINE GROUND STRAP
NEGATIVE COIL TERMINAL
IGNITION COIL
DASH PANEL
88472311

Fig. 10 Ignition coil mounting—all 1989-92 models

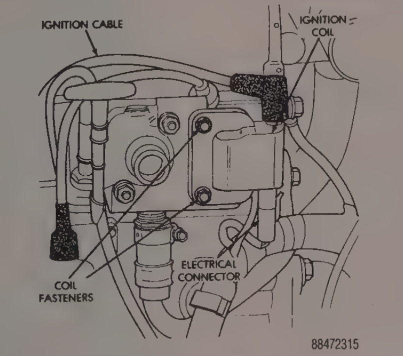

IGNITION CABLE
IGNITION COIL
COIL FASTENERS
ELECTRICAL CONNECTOR
88472315

Fig. 11 Ignition coil wiring and mounting hardware—1993-96 2.5L engine

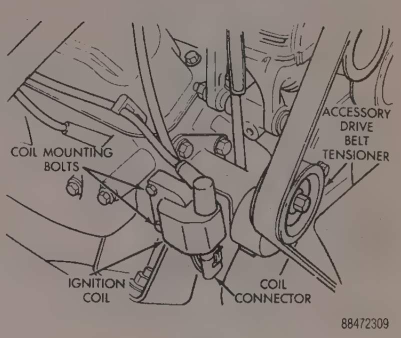

ACCESSORY DRIVE BELT TENSIONER
COIL MOUNTING BOLTS
IGNITION COIL
COIL CONNECTOR
88472309

Fig. 12 Ignition coil mounting—1993-96 3.9L and 5.2L/5.9L LDC engines

IGNITION COIL RESISTANCE

Application/Type	Primary Resistance (70-80°F/21-27°C)	Secondary Resistance (70-80°F/21-27°C)
'89-'96 2.5L D/Diamond	0.96-1.18 Ohms	11,300-15,300 Ohms
'89-'96 2.5L D/Toyodenso	0.95-1.20 Ohms	11,300-13,300 Ohms
'89-'92 D V6/V8/Prestolite	1.34-1.55 Ohms	9,400-11,700 Ohms
'89-'92 D V6/V8/Essex	1.34-1.55 Ohms	9,000-12,200 Ohms
'89-'92 D V6/V8/Diamond	1.34-1.55 Ohms	15,000-19,000 Ohms
'89-'92 R 3.9/5.2L/Diam.	0.96-1.18 Ohms	11,300-15,300 Ohms
'89-'92 R 3.9/5.2L/Toyo.	0.95-1.20 Ohms	11,300-13,300 Ohms
'89-'92 R 5.9L/Prestolite	1.34-1.55 Ohms	9,400-11,700 Ohms
'89-92 R 5.9L/Essex	1.34-1.55 Ohms	9,000-12,200 Ohms
'89-'92 R 5.9L/Diamond	1.34-1.55 Ohms	15,000-19,000 Ohms
'93-'96 ALL/Diamond	0.97-1.18 Ohms	11,300-15,300 Ohms
'93-'96 ALL/Toyodenso	0.95-1.20 Ohms	11,300-13,300 Ohms

D-Dakota
R-Ram/Ramcharger

88472322

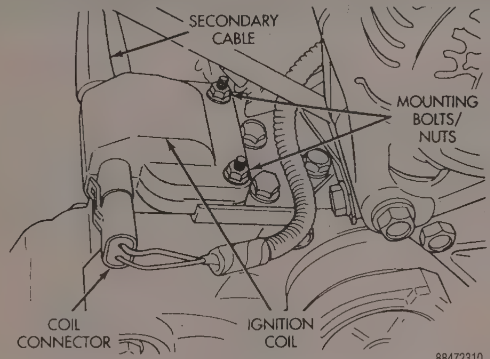


Fig. 13 Ignition coil mounting—1993-96 5.9L HDC engine

The ignition coil for the vehicles covered by this manual is in the following locations:

- 1989-92 engines-mounted to the firewall
- 1993-96 2.5L engines-mounted on the thermostat housing in front of the coolant temperature sensor
- 1993-96 V6 and V8 LDC engines-mounted to a bracket bolted to the right engine cylinder head
- 1993-96 5.9L HDC engines-mounted to a bracket bolted to the air injection pump (AIR pump) mounting bracket.

1. Inspect the ignition coil for arcing while the engine is running. If the engine will not start, this can be performed while the engine is cranked by either an assistant or a remote starter. Look at the coil in dim or low light to aid visibility of any arcing.
2. Arcing at the tower will carbonize the wire boot, which, if it is connected to a new ignition coil, will cause the coil to fail. In such cases, clean all the carbonization away or replace the components as necessary.
3. Using a coil tester or ohmmeter according to the manufacturer's instructions, test the primary and secondary resistance. Replace any coil that does not meet the specifications indicated in the accompanying chart.
4. Inspect the secondary coil wire for any sign of damage. Replace if any damage is found. Carbon tracking on the old wire can cause arcing and the failure of a new ignition coil.

REMOVAL & INSTALLATION

1989-92 Models

➧ See Figures 14 and 15

1. Disconnect the negative battery cable.
2. Disconnect the three wires from the coil. Mark them to identify for installation.
3. Unplug the condenser suppressor connector from the coil, if equipped.
4. Unbolt and remove the coil.
5. Installation is the reverse of removal. Secure all wires in their proper locations.

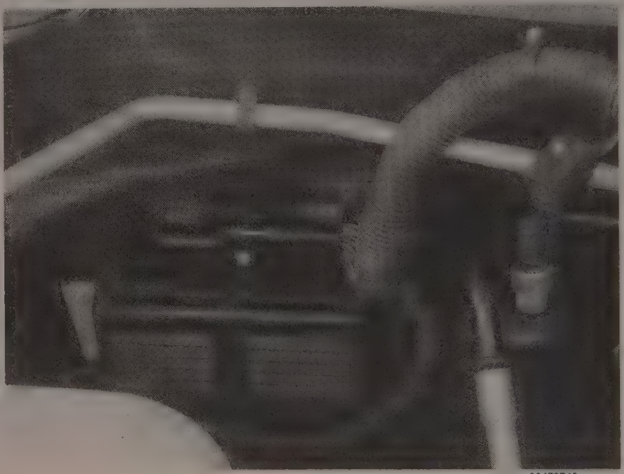


Fig. 14 Remove the coil bracket bolt at the cowl

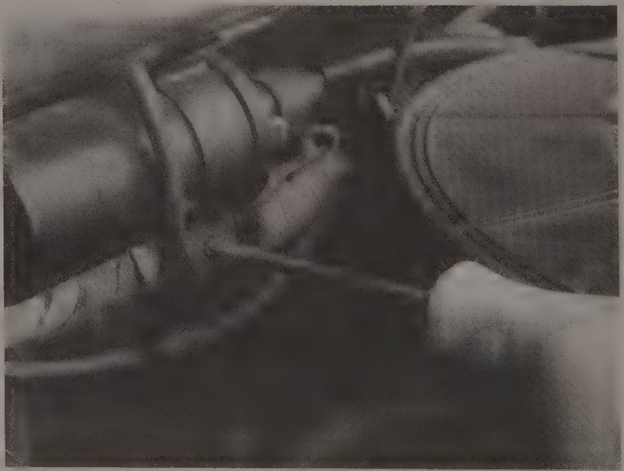


Fig. 15 Unscrew the coil mounting hardware, then remove the coil from the vehicle

1993-96 Models

2.5L ENGINE

1. Disconnect the negative battery cable.
2. Disconnect the ignition secondary wire from the coil.
3. Unplug the engine harness connector from the coil.
4. Remove the ignition coil mounting screws. Remove the coil.
5. Installation is the reverse of removal. Secure all wires in their proper locations.

V6 AND V8 ENGINES

◆ See Figures 12 and 13

1. Disconnect the negative battery cable.
2. Disconnect the primary wiring from the ignition coil.
3. Disconnect the secondary spark plug wire from the coil.
4. Remove the two bolts and withdraw the coil from its mounting bracket.
5. Installation is the reverse of removal.
6. Position the coil on its bracket and install the two bolts. Tighten them to 100 inch lbs. (11 Nm). If the bracket has been tapped for coil mounting bolts, these fasteners require less torque, so tighten them to 50 inch lbs. (5 Nm).

Ignition Module

REMOVAL & INSTALLATION

The engine controller is the computer/microprocessor that regulates all ignition functions. All other models (1989-96) employ a 60-way connector. The 1989 models (only) employ an additional 14-way connector. In most cases, the engine controller is mounted in the engine bay to the firewall or a fender. Some early models mount the engine controller in an air duct mounted on the inside left fender. Access to these units hidden in the air duct requires some dismantling of the air duct to get to them.

✲✲ WARNING

Do not remove the grease from the 14-way connector or the connector terminal in the computer. The grease is used to prevent corrosion of the terminals. There should be at least a 1/8 in. (3.1mm) coating of grease on the bottom of the connector terminals. If not, apply a liberal coating of Mopar Multi-purpose grease No. 2932524, or equivalent, over the entire end of the connector plug.

1. Disconnect the negative battery cable.
2. Remove the air cleaner duct from the controller, if equipped.
3. Remove the three module retaining screws.
4. Remove the 14-way (1989 models) and 60-way connectors from the controller.

➡Check the 14-way and 60-way connectors for damaged or bent pins (and correct if any are found) prior to plugging it in.

5. Installation is the reverse of removal.

Distributor

REMOVAL

◆ See Figures 16 thru 25

1. Remove the splash shield (if equipped).
2. If necessary, remove the air cleaner assembly and connecting tubes.
3. Unplug the pickup lead wire connector(s) from the wiring harness.
4. Leaving the distributor wires connected, unfasten the clips or screws that retain the distributor cap and lift off the cap.

➡If insufficient clearance is obtained by removing the cap with the wires still connected, all or some of the spark plug wires should be tagged and disconnected from the cap for better access.

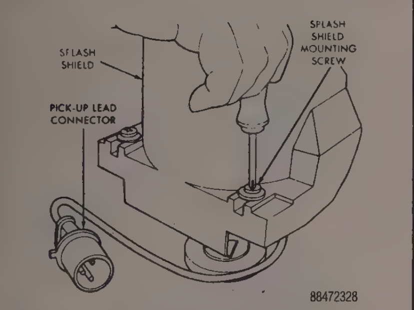

SPLASH SHIELD MOUNTING SCREW
SPLASH SHIELD
PICK-UP LEAD CONNECTOR
88472328

Fig. 16 Use a Phillips screwdriver to remove the retaining screws for the distributor pickup lead and splash shield—2.5L engine

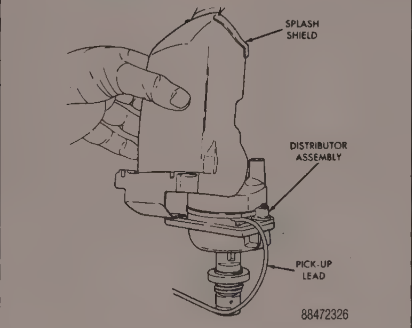

SPLASH SHIELD
DISTRIBUTOR ASSEMBLY
PICK-UP LEAD
88472326

Fig. 17 Once detached, remove the splash shield on 2.5L engines to gain access to the distributor

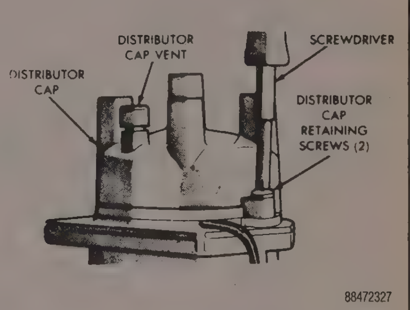

DISTRIBUTOR CAP VENT
SCREWDRIVER
DISTRIBUTOR CAP
DISTRIBUTOR CAP RETAINING SCREWS (2)
88472327

Fig. 18 Unscrew the distributor cap retaining screws—2.5L engine

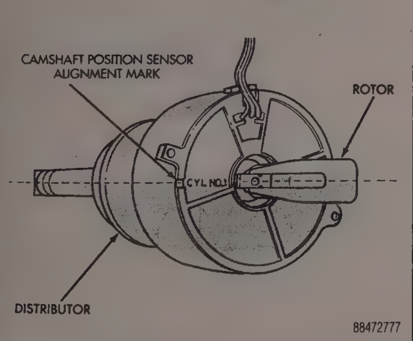

CAMSHAFT POSITION SENSOR ALIGNMENT MARK
ROTOR
CYL NO.1
DISTRIBUTOR
88472777

Fig. 19 Rotor alignment mark—V6 and V8 engines

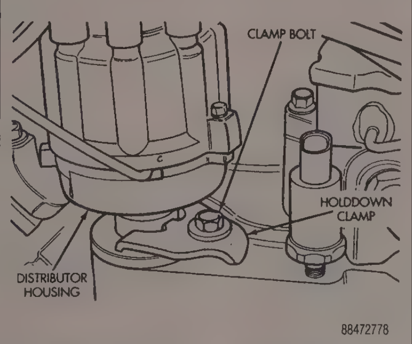

CLAMP BOLT
HOLDDOWN CLAMP
DISTRIBUTOR HOUSING
88472778

Fig. 20 Remove the distributor hold-down clamp—V6 and V8 engines

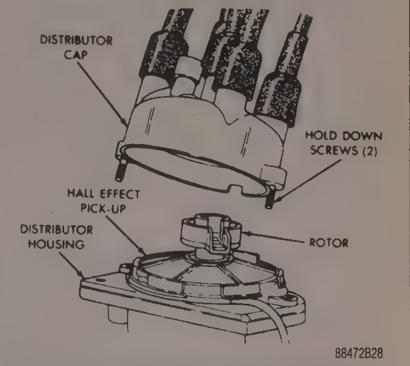

DISTRIBUTOR CAP
HOLD DOWN SCREWS (2)
HALL EFFECT PICK-UP
DISTRIBUTOR HOUSING
ROTOR
88472B28

Fig. 21 Remove the cap with the wires connected—2.5L engine shown

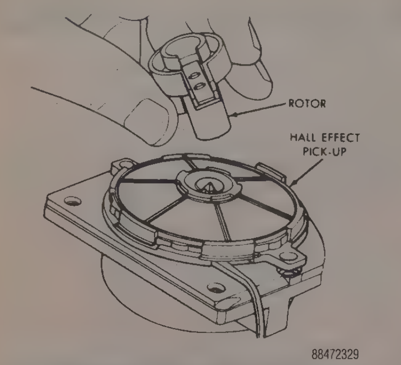


Fig. 22 Remove the ignition rotor by simply lifting it out—2.5L engine

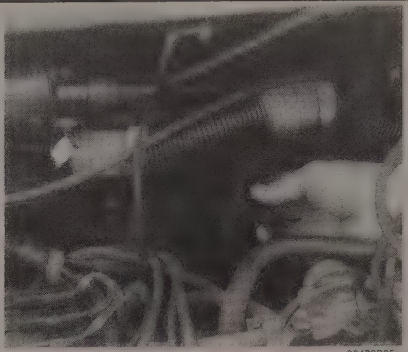


Fig. 23 Unbolt and remove the distributor hold-down clamp

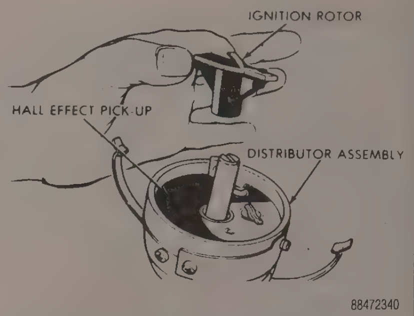


Fig. 24 Install the ignition rotor by aligning the grooves—V6 and V8 engines

Fig. 25 When fully detached, lift the distributor out of the vehicle

5. Bump the engine around until the rotor is pointing at No. 1 cylinder firing position, with the timing marks on the front case and crank pulley are aligned. Disconnect the negative battery cable from the battery.
6. Mark the distributor body and the engine block to indicate the position of the distributor in the block. Mark the distributor body to indicate the rotor position. These marks are used as guides when installing the distributor.
7. Remove the distributor hold-down bolt and bracket. Carefully lift the distributor from the engine. The shaft may rotate slightly as the distributor is removed. Make a note of where the movement stops. That is where the rotor must point when the distributor is reinstalled into the block.

INSTALLATION

Ignition Timing Undisturbed

1. If the crankshaft has not been rotated while the distributor was removed from the engine, use the reference marks made before removal to correctly position the distributor in the block. The shaft may have to be rotated slightly to engage the intermediate shaft gear (V6 and V8).
2. Install the distributor while holding the rotor in position, allowing it to move only enough to engage the slot in the drive gear.
3. Install pickup coil leads and distributor cap. Make sure all high tension wires are firmly snapped in cap towers. Install distributor hold-down clamp screw and tighten to 200 inch lbs. (22 Nm).

Ignition Timing Disturbed

➧ See Figures 26 and 27

Perform this procedure if the crankshaft was rotated or otherwise distributed (for example, during engine rebuilding) after the distributor was removed.

1. Rotate the crankshaft until the No. 1 cylinder is at Top Dead Center (TDC) of the compression stroke. The simplest way to do this is to remove the spark plug from the No. 1 cylinder and place your thumb over the hole. Slowly turn the engine by hand in the normal direction of rotation until compression is felt at the hole.

➡Other ways to check for TDC of the compression stroke: The most failsafe (and time consuming) way is to remove the cylinder head cover and crank the engine until both the intake and exhaust valves are closed. Or you could use a compression gauge to determine that as you rotate the engine, the piston is coming up on compression. Also there are specialty tools available that screw in the sparkplug hole (like a compression tester) and whistle as you rotate the engine into its compression stroke. In all cases, verify the timing mark is at 0 degrees when you believe you have found TDC.

2. Ensure that the indicating mark on the crankshaft vibration damper is aligned to the 0 degree (TDC) mark on the timing chain cover.
3. Clean the distributor mounting at the engine and distributor base. Lightly oil the rubber O-ring seal on the distributor housing.

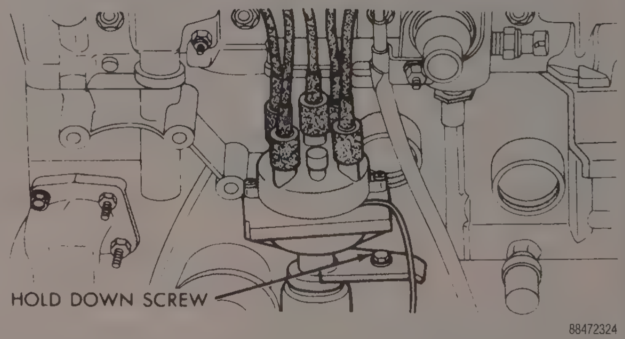


Fig. 26 Distributor hold-down bolt location—2.5L engine

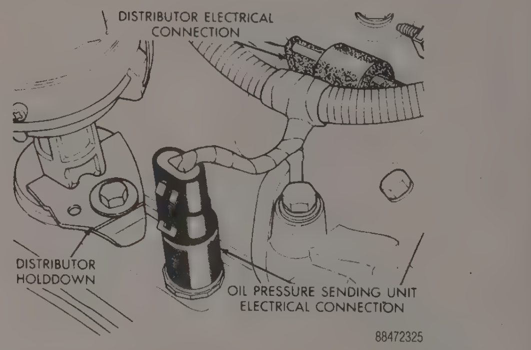

DISTRIBUTOR ELECTRICAL CONNECTION
DISTRIBUTOR HOLDDOWN
OIL PRESSURE SENDING UNIT ELECTRICAL CONNECTION
88472325

Fig. 27 Distributor hold-down bolt location—V6 and V8 engines

4. Hold the distributor over the mounting pad on the cylinder block so that the distributor body flange coincides with the mounting pad and the rotor points to the No. 1 cylinder firing position.
5. Install the distributor while holding the rotor in position, allowing it to move only enough to engage the slot in the drive gear.
6. Install pickup coil leads and distributor cap. Make sure all high tension wires are firmly snapped in cap towers. Install distributor hold-down clamp screw and tighten to 200 inch lbs. (22.5 Nm).

Crankshaft and Camshaft Position Sensors

For more information and service procedures, please refer to Section 4, under Electronic Engine Controls.

DISTRIBUTORLESS IGNITION SYSTEM

General Information

See Figures 28 and 29

The distributorless ignition system, used exclusively for the V10 engine, does not use a conventional mechanical distributor. It is otherwise very similar in function and operation to electronic ignitions found in other Plymouth/Dodge trucks and uses many similar components to the other trucks as well.

The function normally handled by the distributor is given to the Powertrain Control Module (PCM) and an additional Ignition Control Module (ICM). The PCM is a computer containing a microprocessor that sends and receives signals to monitor and regulates engine operation. By controlling the coil ground circuit, the PCM is able to set base timing and adjust the ignition timing advance to meet changing engine operating conditions.

The PCM advances or retards ignition timing based the transmission gear selection and on vital data signals it receives from the following sensors:

- The Engine coolant temperature sensor
- The Crankshaft position sensor
- The Camshaft position sensor
- The Manifold Absolute Pressure (MAP) sensor
- The throttle position sensor

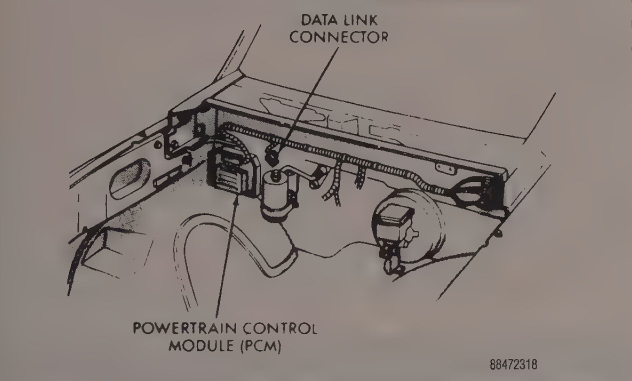


Fig. 28 The Powertrain Control Module (PCM) is commonly located on the firewall—distributorless ignition system

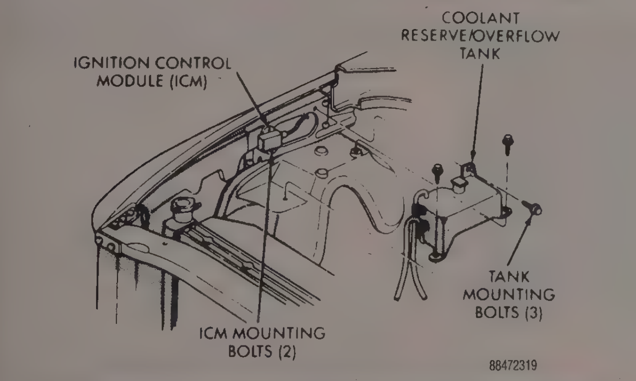


Fig. 29 The Ignition Control Module (ICM) is mounted as shown—Ram trucks equipped with the V10 engine

Diagnosis and Testing

⁂ CAUTION

Do not attempt to pull a spark plug wire off to test against an engine ground. Not only could expensive components be destroyed, but the extremely high voltage from the coil pack could inflict a very powerful shock causing injury or death.

Conventional tests for spark are not recommended for the distributorless ignition system because of the fundamentally different means by which the coil packs are energized. It's not just a simple matter of pulling off a wire from a distributor and cranking the engine. If you wish to check the coils, please refer to the ignition coil pack tests for more information. Other relevant information on the various engine sensors may also be found in this section. Please refer to the index for assistance.

Ignition Coil Pack

The distributorless ignition system makes use of two epoxy-filled coil packs (containing a total of five independent coils), which are attached to a common mounting bracket above the engine's right-side cylinder head cover. The front coil pack fires six cylinders and the rearward coil pack fires four cylinders.

When one of the five independent coils discharges, it fires the spark plugs of two paired cylinders at the same time (one cylinder is on the compression stroke and the other cylinder is on the exhaust stroke). The cylinder pairs which share one of the five independent coils are cylinders No. 5/10, 9/8, 1/6, 7/4 and 3/2.

The signals to fire the coil are sent via an electronic chain of command. The Automatic Shutdown (ASD) relay, after receiving signals from the crankshaft and camshaft position sensors, supplies battery voltage to all of the ignition coil positive terminals. If these signals are not received by the PCM after approximately one second of engine cranking (start-up), the ASD relay will shut off the positive voltage to the coils. Coil firing is then controlled by switching ground circuits (off-and-on) through the PCM. The PCM determines cylinder identification after receiving signals from the crankshaft and camshaft position sensors.

The PCM controls the ground path circuits for paired cylinders No. 1/6, 3/2 and 9/8. Also unique to this system is the utilization of the ICM. The ICM controls the ground path circuits for the (remaining) two of the five paired coil packs used by this engine: 4/7 and 5/10.

TESTING

See Figures 30, 31, 32 and 33

This procedure requires an ohmmeter to test the coil packs for primary and secondary resistance (specifications are given for an ambient temperature of 70-80°F/21-27°C).

1. Disconnect the negative battery cable.
2. Determine the manufacturer of the coil. It should be labeled either a Diamond or Toyodenso.
3. Check the secondary resistance of each individual paired coil by connecting an ohmmeter across the coil towers. This must be done between the correct cylinder pairs: 3/2, 7/4, 1/6, 9/8, or 5/10. Resistance for a Diamond coil should be 11,300-15,300 ohms. For a Toyodenso manufactured coil pack, resistance should be 11,300-13,300 ohms.
4. Check the primary resistance of the front coil pack by attaching an ohmmeter between the B+ coil terminal and either the right (cylinders 3/2), center (cylinder 7/4), or left coil (cylinders 1/6) terminals. Resistance for a Diamond

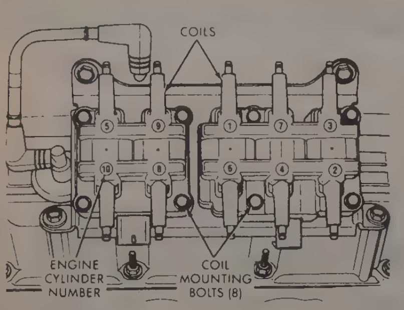

COILS
ENGINE CYLINDER NUMBER
COIL MOUNTING BOLTS (8)
5
9
1
7
3
10
8
6
4
2
88472320

Fig. 30 The two coil packs contain five independent coils, which fire paired cylinders (shown numbered)

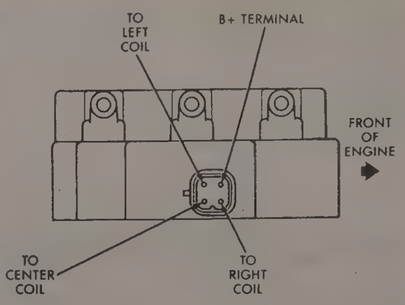

TO LEFT COIL
B+ TERMINAL
FRONT OF ENGINE
TO CENTER COIL
TO RIGHT COIL
88472779

Fig. 31 Location of critical terminals for checking the coil primary resistance—V10 engine front coils

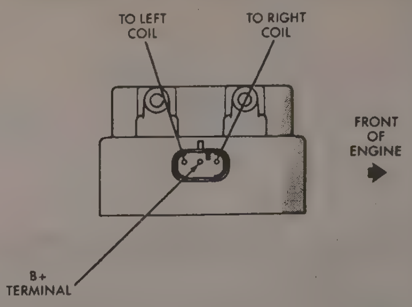

TO LEFT COIL
TO RIGHT COIL
FRONT OF ENGINE
B+ TERMINAL
88472780

Fig. 32 Location of critical terminals for checking the coil primary resistance—V10 engine rear coils

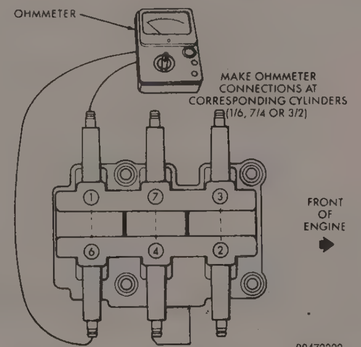

OHMMETER
MAKE OHMMETER CONNECTIONS AT CORRESPONDING CYLINDERS (1/6, 7/4 OR 3/2)
FRONT OF ENGINE
1
7
3
6
4
2
88472323

Fig. 33 Use an ohmmeter to check secondary resistance as shown

coil should be 0.97-1.18 ohms. Resistance for a Toyodenso coil should be 0.95-1.20 ohms.

5. To test the primary resistance of the rear coil pack, attach an ohmmeter between the B+ coil terminal (see illustration) and either the right (cylinders 9/8), or left (cylinders 5/10) coil terminals. Resistance for a Diamond coil should be 0.97-1.18 ohms. Resistance for a Toyodenso coil should be 0.95-1.20 ohms.

REMOVAL & INSTALLATION

➧ See Figures 34, 35 and 36

1. Disconnect the negative battery cable.
2. Tag and remove the spark plug wires from the coil packs.
3. Disconnect the wiring harness from the coil packs.
4. Remove the four coil pack-to-bracket bolts for the unit being serviced. Remove the coil pack.
5. Installation is the reverse of removal. The four wire connector should be hooked to the front coil pack, and the three wire connector to the rear coil pack.

Ignition Module

REMOVAL & INSTALLATION

Powertrain Control Module (PCM)

The PCM is located in the right-rear side of the engine compartment. It is mounted to the dash cowl with three bolts.

1. Disconnect the negative battery cable.
2. Remove the three module retaining bolts.
3. Remove the 60-way connectors from the controller.
4. Installation is the reverse of removal. Secure the 60-way connectors bolt to 35 inch lbs. (4 Nm) and the module retaining bolts to 9 inch lbs. (1 Nm).

➡Check the 60-way connector for damaged or bent pins (and correct if any are found) prior to plugging it in.

Ignition Control Module

The ICM is located in the engine compartment, mounted to the right inner fender behind the coolant reservoir/overflow tank.

1. Disconnect the negative battery cable.
2. Remove the three bolts that secure the coolant reservoir/overflow tank to the inner fender. Leave the hose attached and the coolant in the tank and set it aside where it won't get tipped over.
3. Disengage the electrical connector at the ICM, then unscrew the two bolts securing the unit, and remove it from the vehicle.
4. Installation is the reverse of removal.

Crankshaft and Camshaft Position Sensor

The crankshaft and camshaft position sensors are utilized by the V10 engine. For more information and service procedures, please refer to Section 4, under Electronic Engine Controls.

Fig. 34 If not already marked, label or tag the spark plug wires at the coil pack prior to removal

Fig. 35 Remove the labeled wires from the coil pack

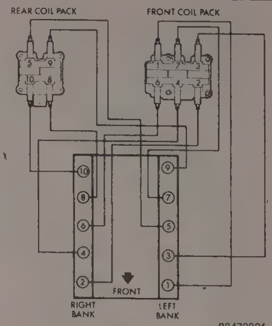

REAR COIL PACK
FRONT COIL PACK
5
9
10
8
1
7
3
6
4
2
FRONT
RIGHT BANK
LEFT BANK
88472321

Fig. 36 Each coil sends high voltage through the spark plug wires to its paired cylinders

FIRING ORDERS

See Figures 37, 38, 39 and 40

➡To avoid confusion, remove and tag the spark plug wires one at a time, for replacement.

If a distributor is not keyed for installation with only one orientation, it could have been removed previously and rewired. The resultant wiring would hold the correct firing order, but could change the relative placement of the plug towers in relation to the engine. For this reason it is imperative that you label all wires before disconnecting any of them. Also, before removal, compare the current wiring with the accompanying illustrations. If the current wiring does not match, make notes in your book to reflect how your engine is wired.

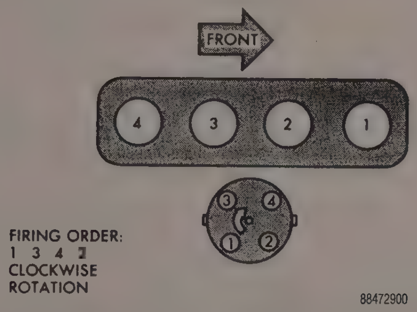

FRONT
4
3
2
1
3
4
1
2
FIRING ORDER:
1 3 4 2
CLOCKWISE
ROTATION
88472900

Fig. 37 2.5L 4-cylinder Engine
Engine Firing Order: 1-3-4-2
Distributor Rotation: Clockwise

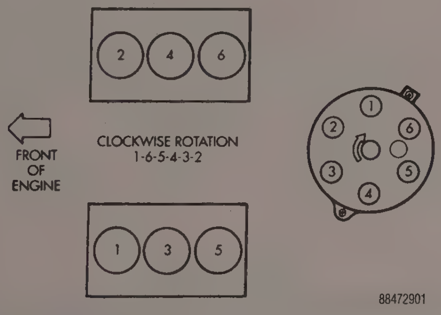

2
4
6
FRONT
OF
ENGINE
CLOCKWISE ROTATION
1-6-5-4-3-2
1
2
6
3
5
4
1
3
5
88472901

Fig. 38 3.9L V6 Engine
Engine Firing Order: 1-6-5-4-3-2
Distributor Rotation: Clockwise

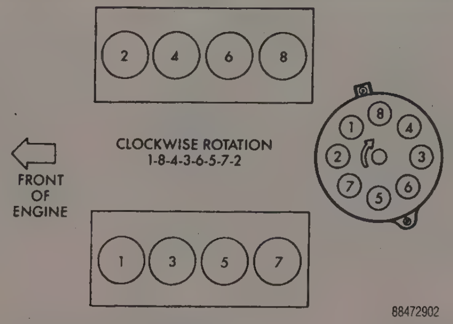

2
4
6
8
FRONT
OF
ENGINE
CLOCKWISE ROTATION
1-8-4-3-6-5-7-2
8
1
4
2
3
7
5
6
1
3
5
7
88472902

Fig. 39 5.2L and 5.9L V8 Engines
Engine Firing Order: 1-8-4-3-6-5-7-2
Distributor Rotation: Clockwise

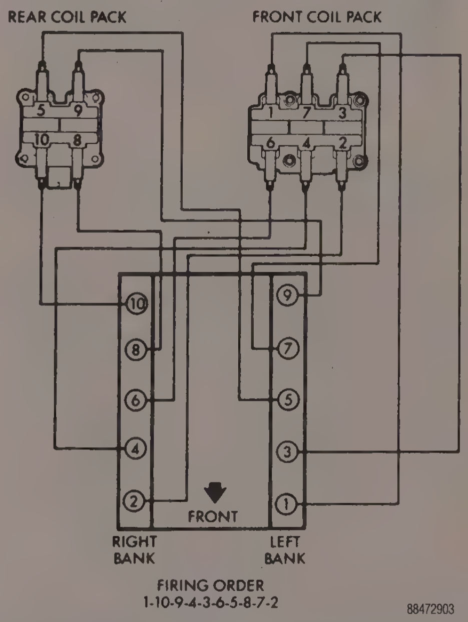

REAR COIL PACK
FRONT COIL PACK
5
9
10
8
1
7
3
6
4
2
10
8
6
4
2
9
7
5
3
1
FRONT
RIGHT
BANK
LEFT
BANK
FIRING ORDER
1-10-9-4-3-6-5-8-7-2
88472903

Fig. 40 8.0L V10 Engine
Engine Firing Order: 1-10-9-4-3-6-5-8-7-2
Distributorless Ignition

CHARGING SYSTEM

Alternator

PRECAUTIONS

To prevent damage to the alternator and regulator, the following precautions should be taken when working with the electrical system.

- Never reverse the battery connections. This would cause BIG PROBLEMS!
- Booster batteries for starting must be connected properly: positive-to-positive and negative-to-ground.
- Disconnect the battery cables before using a fast charger; the charger has a tendency to force current through the diodes in the opposite direction for which they were designed. This burns out the diodes.
- Never use a fast charger as a booster for starting the vehicle.
- Never disconnect the voltage regulator while the engine is running.
- Avoid long soldering times when replacing diodes or transistors. Prolonged heat is damaging to AC generators.
- Do not use test lamps of more than 12 volts (V) for checking diode continuity.
- Do not short across or ground any of the terminals on the AC generator.
- The polarity of the battery, generator, and regulator must be matched and considered before making any electrical connections within the system.
- Never operate the alternator on an open circuit. make sure that all connections within the circuit are clean and tight.
- Disconnect the battery terminals when performing any service on the electrical system. This will eliminate the possibility of accidental reversal of polarity.
- Disconnect the negative battery cable if arc welding is to be done on any part of the vehicle.

TESTING

See Figure 41

An On-Board Diagnostic (OBD) system is incorporated into all gasoline models. It is controlled by the engine controller. The engine controller monitors critical input and output circuits of the charging system, making sure they are in good working order. Some are checked continuously, and some are monitored under certain conditions.

If the OBD system senses a problem, it will enter a fault code into the system memory and illuminate the CHECK ENGINE light. The fault code will remain as long as the problem persists. However if the problem does not reappear after 50-100 engine starts, the computer will automatically clear its memory.

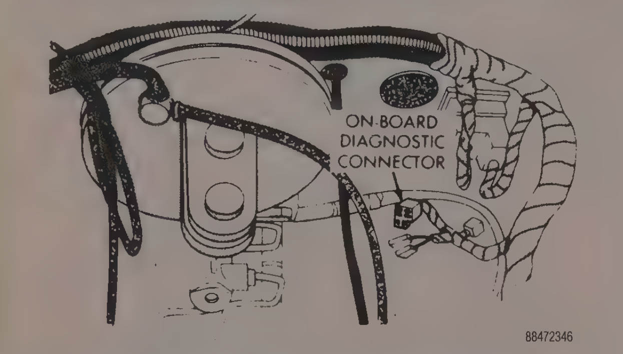


Fig. 41 The OBD diagnostic connector allows a special test instrument to determine faults in the vehicle's engine operation

Fault codes are numbers which identify the bad circuit. However they will not identify which component in the circuit has failed. The fault codes can be read by switching the function of the CHECK ENGINE light so as to cause it to flash the two-digit code(s) in sequence (refer to the portion of Section 4 for more information on reading codes). A special diagnostic instrument called the DRBII scan tool may also be used to access and display the fault codes for diagnosis. The tool is connected to the diagnostic (data link) connector and activates from one to five automatic test modes to aid in trouble diagnosis.

There are many possible ways in which the charging system can malfunction. Often the source of a problem is difficult to diagnose, requiring special equipment and a good deal of experience. This is usually not the case, however, when the charging system fails completely and causes the dash board warning light to come on or the battery to become dead. To troubleshoot a complete system failure only two pieces of equipment are needed: a test light, to determine that current is reaching a certain point; and a current indicator (ammeter), to determine the direction of the current flow and its measurement in amps. This test works under three assumptions:

- The battery is known to be good and fully charged.
- The alternator belt is in good condition and adjusted to the proper tension.
- All connections in the system are clean and tight.

➡**In order for the current indicator to give a valid reading, the truck must be equipped with battery cables which are of the same gauge size and quality as original equipment battery cables.**

1. Turn off all electrical components on the truck. This includes making sure the doors of the truck are closed (to shut off interior light(s).
2. If the truck is equipped with a clock, disconnect the clock by removing the lead wire from the rear of the clock.
3. Disconnect the positive battery cable from the battery and connect the ground wire on a test light to the disconnected positive battery cable.
4. Touch the probe end of the test light to the positive battery post. The test light should not illuminate. If the test light does come on, there is a short or open circuit on the truck.
5. For DIESEL trucks only, disconnect the voltage regulator wiring harness connector at the regulator. Turn the ignition key **ON**.
    a. Connect the wire on a test light to a good ground (engine bolt).
    b. Touch the probe end of a test light to the ignition wire connector into the voltage regulator wiring connector. This wire corresponds to the **I** terminal on the regulator.
    c. If the test light comes on, the charging system warning light circuit is complete.
    d. If the test light does not come on and the warning light on the instrument panel is on, either the resistor wire, which is parallel with the warning light, or the wiring to the voltage regulator, is defective.
    e. If the test light does not come on and the warning light is not on, either the bulb is defective or the power supply wire form the battery through the ignition switch to the bulb has an open circuit.
    f. Connect the wiring harness to the regulator.
6. Examine the fuse link wire in the wiring harness from the starter relay to the alternator. If the insulation on the wire is cracked or split, the fuse link may be melted. Connect a test light to the fuse link by attaching the ground wire on the test light to an engine bolt and touching the probe end of the light to the bottom of the fuse link wire where it splices into the alternator output wire. If the bulb in the test light does not illuminate, the fuse link is melted.
7. Start the engine and place a current indicator on the positive battery cable. Turn off all electrical accessories and make sure the doors are closed. If the charging system is working properly, the gauge will show a draw of less than five amps. If the system is not working properly, the gauge will show a draw of more than five amps. A charge moves the needle toward the battery, a draw moves the needle away from the battery. Turn the engine **OFF.**

REMOVAL & INSTALLATION

See Figures 42 thru 47

1. Disconnect the negative battery cable.
2. Disconnect and label the alternator output (BATT) and field (FLD) leads, then disconnect the ground wire.
3. You may need to spray a lubricant on the existing nuts and bolts for easy removal. Sometime it may be necessary to allow the lubricant to sit for a few minutes.
4. Loosen the alternator adjusting bolt and swing the alternator in toward the engine. Disengage the alternator drive belt. On models with a serpentine belt, release the automatic belt tensioner as described in Section 1.

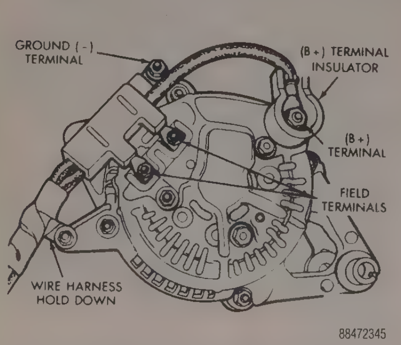


Fig. 42 Detach the connectors shown as depicted on this Dodge truck alternator

Fig. 43 Unfasten the wiring harness from the alternator

Fig. 44 Detach the wiring harness and set it aside; place the hardware in a safe location

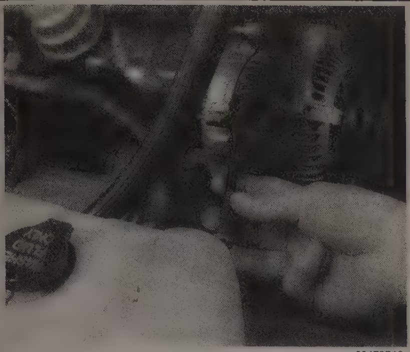


Fig. 45 Remove the alternator adjusting bolt

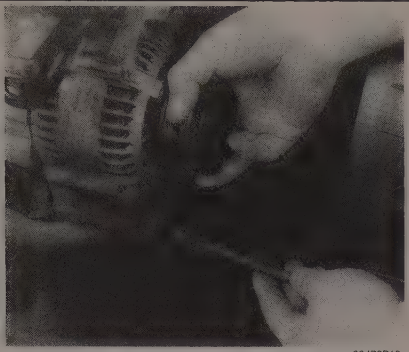


Fig. 46 Remove the rest of the alternator mounting hardware

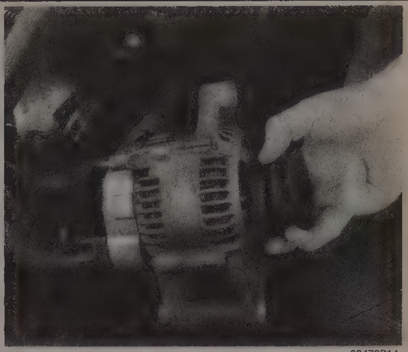


Fig. 47 Remove the alternator and set it in a safe place if you will be re-installing it

5. Remove the alternator mounting bolts and remove the alternator from the vehicle.
6. Installation is the reverse of removal. At first, tighten the bolts, but not all the way, you still need to install the belt. Always inspect your belts before reinstalling an old one, you wouldn't want to do this job over again due to a junk belt.
7. Adjust the belt tension as required (see belt tension adjustment in Section 1).

Regulator

REMOVAL & INSTALLATION

See Figure 48

This procedure covers diesel models only.

On ALL gasoline models there is no separate voltage regulator. The regulator circuitry is contained in the engine controller. If this circuitry is found faulty, the entire engine controller computer must be replaced as a unit.

1. Disconnect the negative battery cable.
2. Release the spring clips and pull off the regulator wiring plug.
3. See if your bolts are rusty or hard to remove, if so use lubricant and allow to sit for a few minutes before removing.
4. Remove the regulator.
5. Installation is the reverse of removal. Make sure the clips are fully engaged.

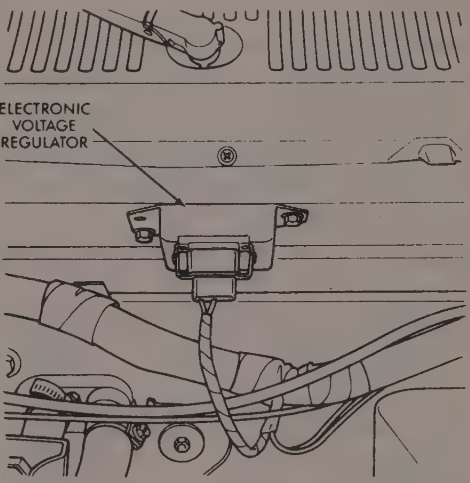


Fig. 48 Pull on the connector body, not the wiring when removing the electronic voltage regulator

STARTING SYSTEM

Starter

TESTING

Before performing any tests, inspect the wiring and connections at the:

- Ignition switch
- Starter relay
- Park/neutral position switch (automatic transmission)
- Battery
- Starter with an integral solenoid

Inspect the solenoid, relay, and ignition switch to determine their condition. If equipped with an automatic transmission, inspect the condition of the park/neutral position switch. If the vehicle is a 1995-96 manual transmission model with a clutch position switch, inspect the condition of the switch.

Cold Cranking Test

See Figures 49, 50 and 51

1. Prepare for the test by performing the following:
    a. Ensure the battery is in good condition and fully charged. If you have doubt about the battery, load test it first. A marginal battery will throw off the results of any electrical test if you don't check for it first.
    b. Connect a suitable volts-ampere tester to the positive and negative battery terminals. Refer to the tester manufacturer's instructions for proper hookup and operation.
    c. Engage the parking brake fully. Place manual transmissions in NEUTRAL, or automatic transmissions in PARK.
    d. Verify that all lamps and accessories are OFF and the doors are closed.
    e. Make sure the engine won't start by disconnecting the Automatic Shutdown (ASD) relay on gas-powered vehicles or the fuel shutdown solenoid connector on diesel vehicles (The relay is on the underside of the PDC cover.)
2. To test the starter output, turn the ignition key to the **START** position.

A cold engine will increase starter current and reduce battery voltage.

3. Read cranking voltage and amperage on the tester.
    a. If voltage is above 9.6 and amperage draw is above 300 amps (gas engine) or 700 amps (diesel engine), see the Starter Feed Circuit Tests.
    b. If voltage is 12.5 volts or greater and amperage is below specifications, see the Control Circuit Tests.

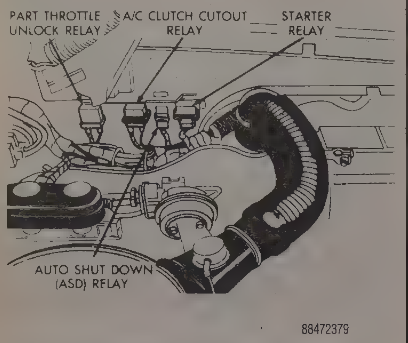

PART THROTTLE UNLOCK RELAY
A/C CLUTCH CUTOUT RELAY
STARTER RELAY
AUTO SHUT DOWN (ASD) RELAY
88472379

Fig. 49 A common ASD relay location on V6 and V8 engines

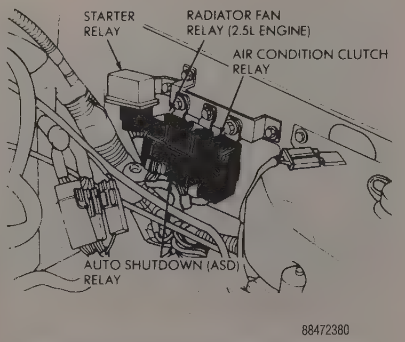

STARTER RELAY
RADIATOR FAN RELAY (2.5L ENGINE)
AIR CONDITION CLUTCH RELAY
AUTO SHUTDOWN (ASD) RELAY
88472380

Fig. 50 A common ASD relay location—2.5L engine

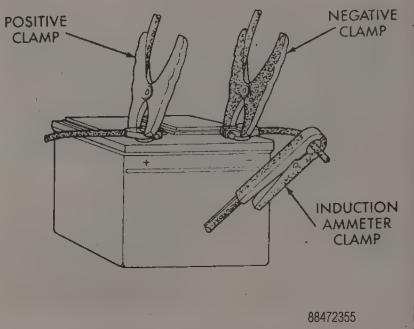

POSITIVE CLAMP
NEGATIVE CLAMP
INDUCTION AMMETER CLAMP
88472355

Fig. 51 You will need to connect a volt-ampere tester to perform the cold cranking

Feed Circuit Test

➧ See Figures 52, 53, 54, 55 and 56

This is a test for excessive resistance in the high amperage circuit. For accurate results, make sure the voltage meter is connected as described: Connect the voltmeter leads to the terminals that the cable connectors or clamps are connected to, not the cable connectors or clamps themselves. For example, when testing between the battery and solenoid, touch the voltmeter leads to the battery post and the solenoid threaded stud.

➡This test will require a voltmeter capable of accurate readings of 1/10 (0.10) volt.

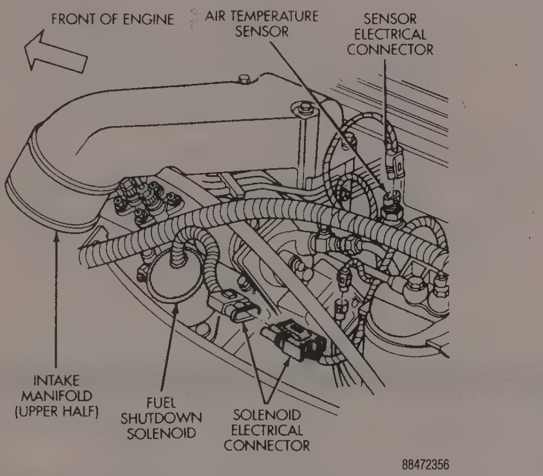

FRONT OF ENGINE
AIR TEMPERATURE SENSOR
SENSOR ELECTRICAL CONNECTOR
INTAKE MANIFOLD (UPPER HALF)
FUEL SHUTDOWN SOLENOID
SOLENOID ELECTRICAL CONNECTOR
88472356

Fig. 52 For diesel engines, you must disable the fuel shutdown solenoid by unplugging it at the harness connector

Before beginning, make sure the parking brake is fully applied, the battery is good and is fully charged and perform the following to prevent unwanted start-up of the engine while testing:

- Gasoline-powered vehicles: Unplug the Auto Shut-Down (ASD) relay from the Power Distribution Center (PDC).
- Diesel engine vehicles: Disconnect the fuel shutdown solenoid connector (see illustration).
- 1995-96 manual transmission models: Install a jumper wire between two clutch position switch connectors.

1. Connect the positive lead of the voltmeter to the battery negative post. Connect the negative lead of the voltmeter to the negative battery cable clamp.
2. Turn the ignition to the **START** position and read the voltmeter. If voltage registers, correct the poor contact between the cable clamp and post.
3. Connect the positive lead of the voltmeter to the battery positive post. Connect the negative lead of the voltmeter to the positive battery cable clamp.
4. Turn the ignition to the **START** position and read the voltmeter. If voltage registers, correct the poor contact between the cable clamp and post.
5. Connect the voltmeter to measure between the battery positive post and the starter solenoid battery stud.
6. Turn the ignition to the **START** position and read the voltmeter. If the voltmeter reads above 0.2 volt, correct the poor battery cable contact at the solenoid.
7. Repeat the test. If the reading is still above 0.2 volt, replace the battery positive cable.
8. Connect the voltmeter to measure between the battery negative post and a good (clean) engine ground.
9. Turn the ignition to the **START** position and read the voltmeter. If the voltmeter reads above 0.2 volt, correct the poor negative battery cable contact at its attaching point.
10. Repeat the test. If the reading is still above 0.2 volt, replace the battery negative cable.
11. Connect the positive lead of the voltmeter to the starter housing. Connect the negative lead of the voltmeter to the negative terminal.
12. Turn the ignition to the **START** position and read the voltmeter. If the voltmeter reads above 0.2 volt, correct the poor starter to engine ground.

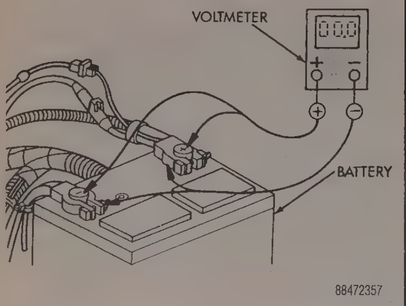

VOLTMETER
00.0
BATTERY
88472357

Fig. 53 Test the battery cable connection voltage drop with a voltmeter

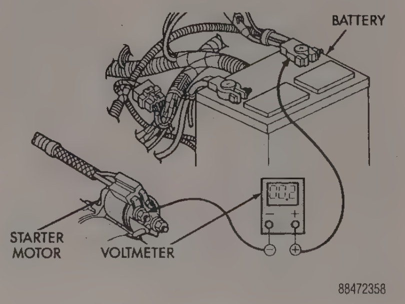

BATTERY
STARTER MOTOR
VOLTMETER
88472358

Fig. 54 Test the battery positive cable voltage drop using a voltmeter

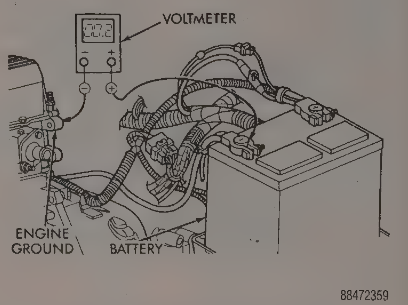
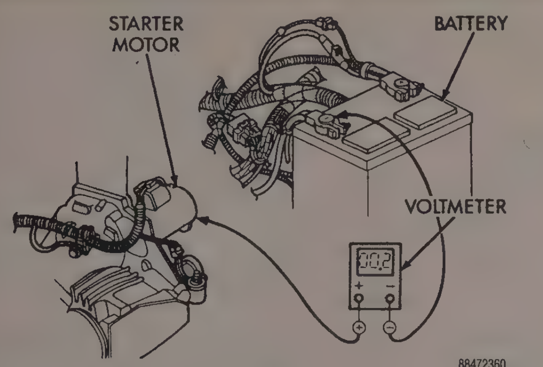

VOLTMETER
ENGINE GROUND
BATTERY
88472359

Fig. 55 Test the ground circuit voltage drop using the voltmeter



88472360

Fig. 56 Test the starter ground as shown

13. If no feed circuit tests are detected in these resistance tests, remove the starter and proceed to the solenoid test.

Control Circuit Tests

➧ See Figure 52

The starter control circuit consists of the following:

- Starter solenoid
- Starter relay
- Ignition switch
- Park/neutral position switch (automatic transmission)
- Clutch pedal position switch (1995-96 manual transmission models only)
- Wiring harness and connections

For gasoline-powered vehicles: Unplug the Automatic Shut-Down (ASD) relay from the Power Distribution Center (PDC). For diesel engine vehicles, disconnect the fuel shutdown solenoid connector.

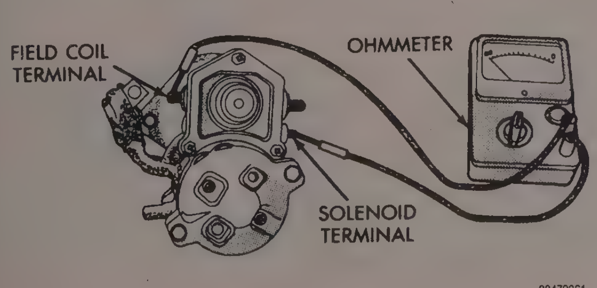
Follow the tests of this group (Solenoid, Relay and Relay Circuit) in the order described.

SOLENOID TEST

➧ See Figures 57 and 58

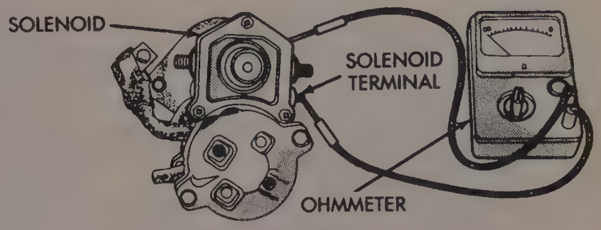
➡This procedure requires a continuity tester.

1. Remove the starter from the vehicle.
2. Disconnect the solenoid field coil wire from the field coil terminal.
3. Check for continuity between the solenoid terminal and field coil terminal. There should be continuity.
4. Check for continuity between the solenoid terminal and solenoid case. There should be continuity. If there is continuity, the solenoid is good. If there is no continuity in either test, the solenoid has an open circuit. Replace the starter assembly.
5. Connect the solenoid field coil wire to the field coil terminal.
6. Install the starter.



88472361

Fig. 57 Test the continuity between the solenoid terminal and the field coil terminal



88472362

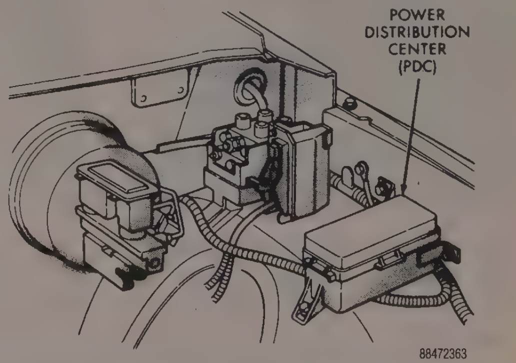
Fig. 58 Test the continuity between the solenoid terminal and the solenoid case

RELAY TEST

➧ See Figures 59 and 60

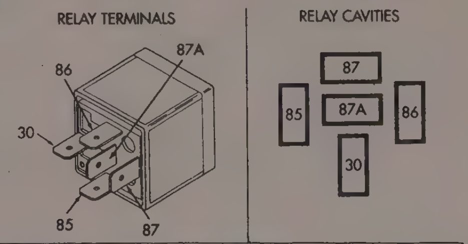
The starter relay is in the Power Distribution Center (PDC). Refer to the underside of the PDC cover for relay location. Remove the starter relay to perform these tests.

1. A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between 87 and 30. If you find otherwise, replace the relay, otherwise proceed to the next step.
2. Check resistance between terminals 85 and 86 (electromagnet). It should be 70-80 ohms. If not replace the faulty relay. If so, continue to the next step.
3. Connect a known good 12 volt battery to terminals 85 and 86. There should be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If not, replace the faulty relay. If so, continue to the relay circuit test.



88472363

Fig. 59 Location of the power distribution center



TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

88472364

Fig. 60 Starter relay connections

RELAY CIRCUIT TEST

➧ See Figure 60

1. Check for battery voltage at the starter relay common feed terminal (30). It should be hot at all times. If it is energized, go to the next step. If not, check the circuit to fuse F12 in the Power Distribution Center (PDC). repair as required.
2. The normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to the next step.
3. The normally open terminal (87) is connected to the battery terminal (30) in the energized position. This terminal supplies battery voltage to the starter solenoid field coils. There should be continuity between the cavity for relay terminal 87 and the starter solenoid terminal at all times. If it is energized, go to the next step. If not, repair the circuit to the solenoid as required.
4. The coil battery terminal (86) is connected to the electromagnet in the relay. It is energized when the ignition switch is in the **START** position. Check for battery voltage at the cavity for relay terminal 86 with the ignition switch in the **START** position. If it is energized, go to the next step. If not, and the vehicle has an automatic transmission, you will need to check the ignition switch for proper operation. If it is not energized and the vehicle is a 1995-96 models with manual transmission, you will need to check the clutch pedal position switch.
5. The coil ground terminal (85) is connected to the electromagnet in the relay. On vehicles with an automatic transmission, it is grounded through the park/neutral position switch. On manual transmission models, it is grounded at all times. Check for continuity to ground at the cavity for relay terminal 85. If not as specified, and the vehicle has a manual transmission, repair the circuit as required. If not as specified and the vehicle has an automatic transmission, you will need to check the park/neutral position switch.

REMOVAL & INSTALLATION

Gasoline Engines

➧ See Figures 61 thru 68

1. Disconnect the negative battery cable.
2. Remove the cable from the starter.
3. Disconnect the solenoid leads at their solenoid terminals. If necessary, tag then to avoid confusion when re-installing.

➡On 4WD Dakota models with the V6 engine, the starter is removed from above. On these models you will have to disconnect the steering gear and position the shaft out of the way to gain working clearance.

4. Remove the starter attachment bolts and withdraw the starter from the engine flywheel housing. On some models with automatic transmissions, the oil cooler tube bracket will interfere with the starter removal. In this case, remove the starter attachment bolts, slide the cooler tube bracket off the stud, and then withdraw the starter.
5. Installation is the reverse of removal. Secure the starter in place using the bolts and washers removed. Tighten the bolts to 50 ft. lbs. (68 Nm).

Diesel Engines

➧ See Figure 69

1. Disconnect the negative battery cable.
2. Raise the truck and support it safely on jackstands.

Fig. 61 Disconnect the wires attached to the starter solenoid to facilitate removal

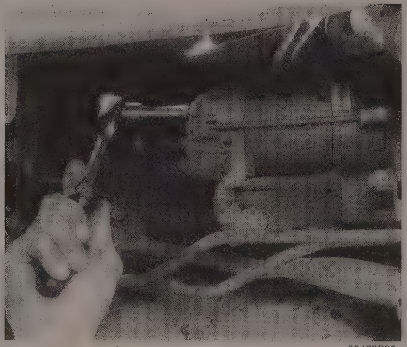


Fig. 62 Unbolt the starter from the vehicle

Fig. 63 Once detached, remove the starter from the vehicle

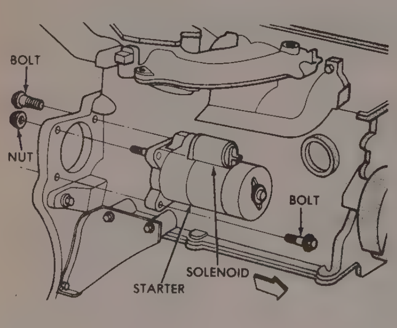


Fig. 64 Exploded view of the starter mounting—2.5L engine

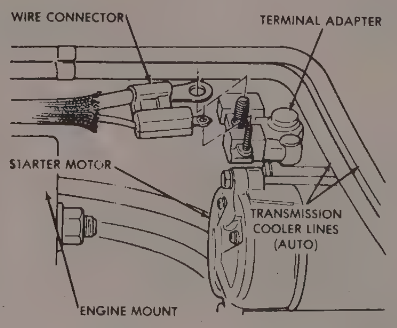


Fig. 65 Attach the starter wire connector to the terminals as shown—V6 and V8 engines

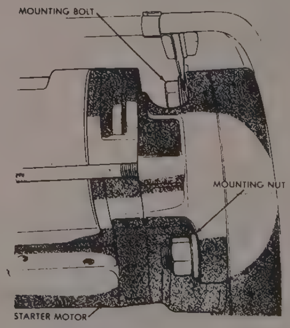


Fig. 66 To remove the starter, unbolt the mounting hardware shown—V6 and V8 engines

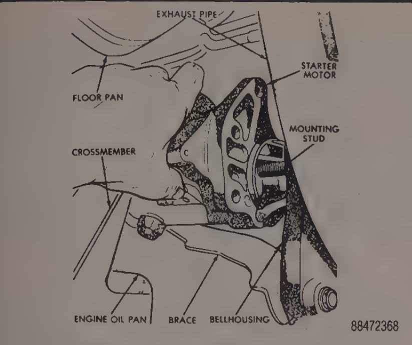

EXHAUST PIPE
STARTER MOTOR
FLOOR PAN
MOUNTING STUD
CROSSMEMBER
ENGINE OIL PAN
BRACE
BELLHOUSING
88472368

Fig. 67 When detached, pull the starter away from the engine and remove it from the vehicle—2WD Dakota model shown

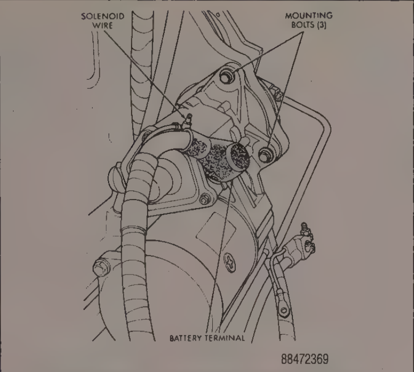

SOLENOID WIRE
MOUNTING BOLTS (3)
BATTERY TERMINAL
88472369

Fig. 68 Install the starter motor on the 4WD Dakota from above as shown

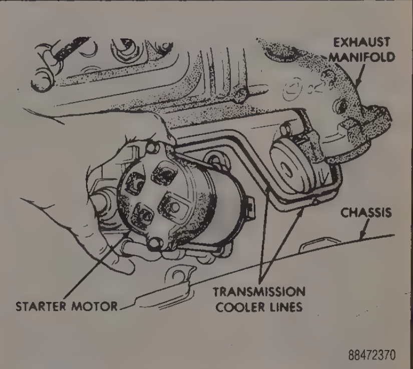

EXHAUST MANIFOLD
CHASSIS
STARTER MOTOR
TRANSMISSION COOLER LINES
88472370

Fig. 69 Starter electrical connections and mounting bolt locations—diesel engine

3. Disconnect and label the wires at the starter motor.
4. Remove the attaching bolt, nut and washer, then lift the starter and solenoid assembly from the engine.
5. Installation is the reverse of removal. Secure the starter bolts to 32 ft. lbs. (43 Nm).
6. Tighten the solenoid connection to 44 inch lbs. (5 Nm). Tighten the battery cable at the starter motor to 16 ft. lbs. (22 Nm).

SOLENOID REPLACEMENT

Chrysler Corp. for 1989-91 models did provide replaceable solenoids for the starter motors covered by this manual. However since 1992, the manufacturer no longer recommends replacement of individual components, even if the later unit has the same part number of a formerly serviceable unit. Chrysler now simply calls for replacement of the entire starter assembly if the solenoid is found faulty.

SENDING UNITS AND SENSORS

The sensors covered in this section pertain to warning systems that inform the vehicle operator of pending failures or problems in the vehicle. They are NOT sensors that transmit engine control data that is used by the engine controller computer to maintain engine operation. For engine control sensors, please refer to Section 4, Electronic Engine Controls.

Coolant Temperature Sensor

OPERATION

➧ See Figures 70, 71, 72 and 73

The coolant temperature sensor is similar to the oil pressure switch. Except in that the temperature sending unit is controlled by the coolant not oil and it reacts to temperature not pressure. When the engine is cold the resistance of the disc in temperature sending unit is high and a low temperature will be indicated on the gauge. When your engine heats up at operating temperature the gauge will be at its normal location between cold and hot. Some gauge needle cycling for the diesel engine is normal depending on vehicle load. However, for gas or diesel vehicles, if your gauge reads **HOT**, or the temperature light comes on, this means there is a potential mechanical problem. Turn **OFF** your engine immediately. Overheating is not a pleasant thing to deal with in rush hour traffic or while on a vacation. We have all seen or at least known someone who has experienced it at one point.

TESTING

➧ See Figures 71, 72 and 73

When a problem occurs with a coolant temperature gauge, the sensor (sending unit) and wiring should be checked.

1. Check the sending unit and wiring by grounding the connector leads at the sending unit.
2. With the ignition **ON**, a grounded gauge will cause the coolant temperature gauge to read at or above maximum.
3. If the gauge does read at or above maximum, it is still operating.

REMOVAL & INSTALLATION

➧ See Figures 71, 72 and 73

➡If the engine has been run recently, allow it time to cool-down before servicing.

1. Disconnect the negative battery cable.
2. Drain the cooling system into a suitable container. Just enough coolant should be removed to drop the system to a level below the sensor.
3. Spray lubricant on the unit, to ensure an easy removal.
4. Disconnect the coolant sensor wires from the unit.

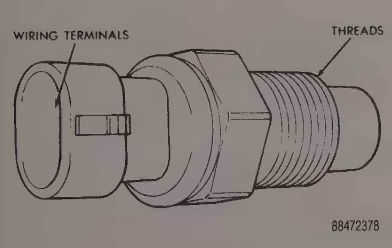

WIRING TERMINALS
THREADS
88472378

Fig. 70 A typical coolant temperature sensor

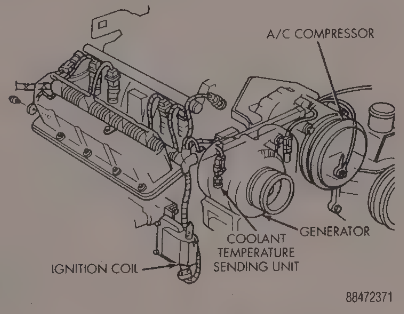

A/C COMPRESSOR
GENERATOR
COOLANT TEMPERATURE SENDING UNIT
IGNITION COIL
88472371

Fig. 71 Coolant temperature sensor location—V6 and V8 engines

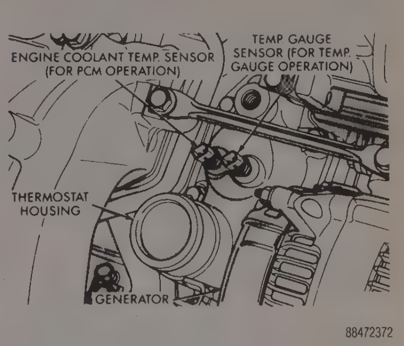

ENGINE COOLANT TEMP. SENSOR (FOR PCM OPERATION)
TEMP GAUGE SENSOR (FOR TEMP. GAUGE OPERATION)
THERMOSTAT HOUSING
GENERATOR
88472372

Fig. 72 Coolant temperature sensor location—V10 engine

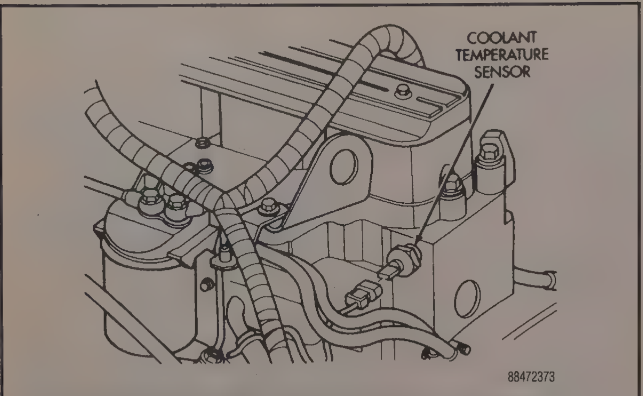


Fig. 73 Coolant temperature sensor location—diesel engine

5. Unscrew the sending unit, using a suitable open-end wrench or a deep socket.
6. Installation is the reverse of removal. Fill the cooling system with coolant.
7. Start the vehicle, and check for leaks. Also check the temperature gauge.

Oil Pressure Sensor

OPERATION

➧ See Figures 74, 75 and 76

➡The oil pressure sending unit and oil pressure gauges are warning switches and need to be taken seriously if the light is on or the gauge reads low. This could mean the death of your engine if ignored long enough-an expensive mistake which can be avoided!

These sensors are mounted on the engine and are controlled by the oil pressure. When the pressure is high, the switch is held in the off or open position allowing no current to flow to the oil pressure warning lamp on the instrument panel. When the oil pressure switch is in the low, on or open position, current is permitted to flow to the oil pressure switch warning lamp. This will cause the light to illuminate telling you that oil is needed immediately. You should always keep a quart of oil in your vehicle at all times in case of such an emergency.

TESTING

➧ See Figures 74, 75, 76 and 77

When a problem occurs with an oil pressure gauge, examine the sensor (sending unit) and its wiring.

1. Check the sending unit and wiring by grounding the connector leads at the sending unit.
2. With the ignition **ON**, a grounded gauge will cause the oil pressure light to come on, or if equipped, the oil pressure gauge to read at or above maximum.
3. If the gauge does read at or above maximum, it is still operating.

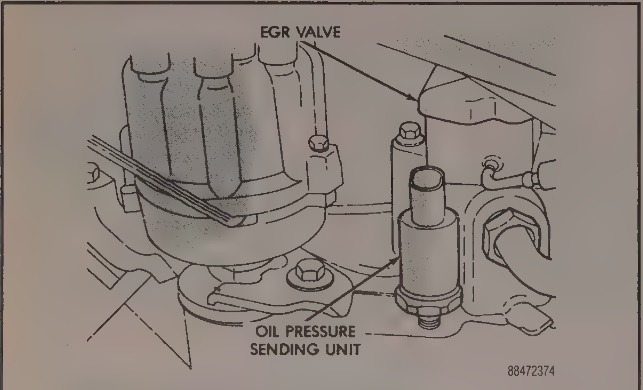


Fig. 74 Oil pressure sensor—V6 and V8 engines

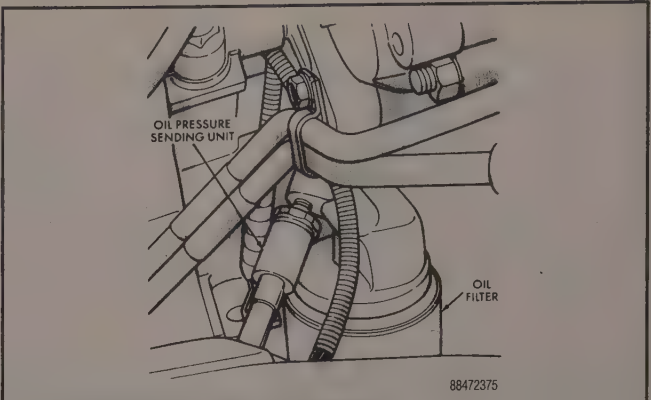


Fig. 75 Oil pressure sensor—V10 engine

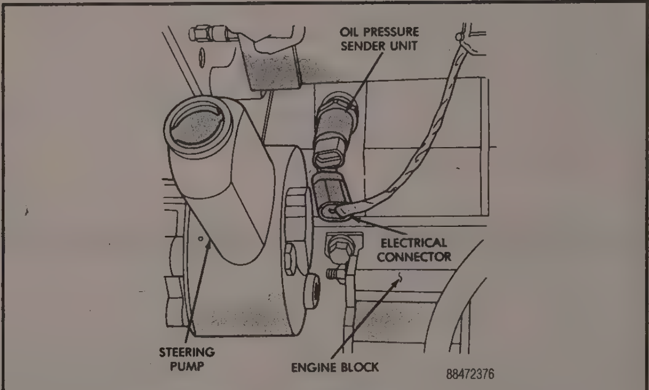
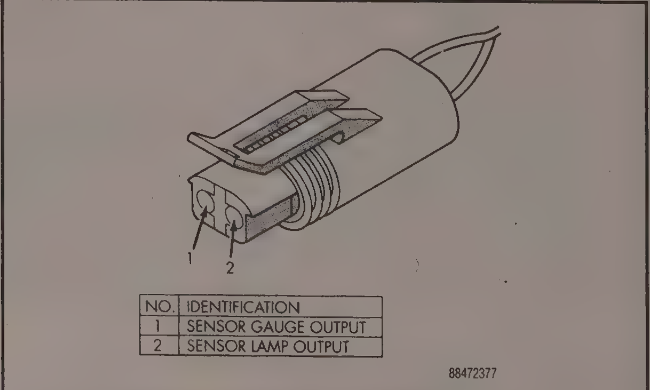


Fig. 76 Oil pressure sensor—diesel engine

REMOVAL & INSTALLATION

➧ See Figures 74, 75 and 76

1. Disconnect the negative battery cable.
2. Disconnect the terminal ends on the unit.
3. Spray lubricant on the unit, to ensure an easy removal.
4. With a suitable open-end wrench or a socket, unscrew the sending unit.
5. Installation is the reverse of removal. Lube the threads with oil on the new sensor and place the O-ring or gasket on the end going into the engine. Carefully thread the sensor by hand, making sure the threads are even, and you are not forcing the sensor into the block. Using a tool, tighten sensor but not to tight as it could break easily.
6. Start engine and look for any leaks in case the sensor is not tight enough.



NO.	IDENTIFICATION
1	SENSOR GAUGE OUTPUT
2	SENSOR LAMP OUTPUT

Fig. 77 A common oil pressure sensor connector

3

ENGINE AND ENGINE OVERHAUL

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EXHAUST SYSTEM 3-60

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ENGINE MECHANICAL

Description

The 2.5L (153 CID) 4-cylinder engine used in the base Dakota model is an in-line, Single Overhead Camshaft (SOHC) design. The cylinders are numbered 1–4 from front to rear.

The 3.9L (238 CID) 6-cylinder engine is a V-type, single camshaft, overhead valve design. The cylinders are numbered from front to rear, 1, 3, 5 on the left bank and 2, 4, 6 on the right bank.

The 5.2L (318 CID), and 5.9L (360 CID) 8-cylinder engines are of a V-type valve-in-head design. The cylinder block and heads are made of iron. The cylinders are numbered from front to rear, 1, 3, 5, 7 on the left bank and 2, 4, 6, 8 on the right bank.

The 5.9L (359 CID) 6-cylinder diesel is an in-line, valve-in-head design manufactured by Cummins. The cylinders are numbered from front to rear, 1–6.

The 8.0L (488 CID) 10-cylinder engine is a V-type, single camshaft, overhead valve design with hydraulic roller tappets. The cylinders are numbered from front to rear, 1, 3, 5, 7, 9 on the left bank and 2, 4, 6, 8, 10 on the right bank.

Engine Overhaul Tips

Most engine overhaul procedures are fairly standard. In addition to specific parts replacement procedures and specifications for your individual engine, this section also is a guide to acceptable rebuilding procedures. Examples of standard rebuilding practice are shown and should be used along with specific details concerning your particular engine.

➡Competent and accurate machine shop services will ensure maximum performance, reliability and engine life.

In most instances it is more profitable for the do-it-yourself mechanic to remove, clean and inspect the component, buy the necessary parts and deliver these to a shop for actual machine work.

On the other hand, much of the rebuilding work (crankshaft, block, bearings, piston rods, and other components) is well within the scope of the do-it-yourself mechanic. You will have to decide for yourself how involved you wish to become.

Aluminum has become extremely popular for use in engines, due to its low weight. Observe the following precautions when handling aluminum parts:

- Never hot tank aluminum parts (the caustic hot tank solution will eat the aluminum.
- Remove all aluminum parts (identification tag, etc.) from iron engine parts prior to the tanking.
- Always coat threads lightly with engine oil or anti-seize compounds before installation, to prevent seizure.
- Never overtorque bolts or spark plugs especially in aluminum threads.

Stripped threads in most any component can be repaired using any of several commercial repair kits (Heli-Coil®, Microdot®, Keenserts®, etc.).

When assembling the engine, any parts that will be in frictional contact must be pre-lubed to provide lubrication at initial start-up. Any product specifically formulated for this purpose can be used, but engine oil is not recommended as a pre-lube. This is especially true if the engine will be sitting unused for an extended period of time.

When semi-permanent (locked, but removable) installation of bolts or nuts is desired, threads should be cleaned and coated with Loctite®or other similar, commercial non-hardening sealant.

TOOLS

The tools required for an engine overhaul or parts replacement will depend on the depth of your involvement. With a few exceptions, they will be the tools found in a mechanic's tool kit. More in-depth work will require any or all of the following:

- A dial indicator (reading in thousandths) mounted on a universal base
- Micrometers and telescope gauges
- Jaw and screw-type pullers
- Gasket scraper
- Valve spring compressor
- Ring groove cleaner
- Piston ring expander and compressor
- Ridge reamer
- Cylinder hone or glaze breaker
- Plastigage®
- Engine stand

The use of most of these tools is illustrated in this section. Occasionally, the use of special tools is called for. Many can be rented for a one-time use from a local parts jobber or tool supply house specializing in automotive work.

INSPECTION TECHNIQUES

Procedures and specifications are given in this section for inspecting, cleaning and assessing the wear limits of most major components. Other procedures such as Magnaflux®and Zyglo®can be used to locate material flaws and stress cracks. Magnaflux®is a magnetic process applicable only to ferrous materials. The Zyglo®process coats the material with a fluorescent dye penetrant and can be used on any material Check for suspected surface cracks can be more readily made using spot check dye. The dye is sprayed onto the suspected area, wiped off and the area sprayed with a developer. Cracks will show up brightly.

REPAIRING DAMAGED THREADS

➧ See Figures 1, 2, 3, 4 and 5

Several methods of repairing damaged threads are available. Heli-Coil®(shown here), Keenserts®and Microdot®are among the most widely used. All involve basically the same principle drilling out stripped threads, tapping the

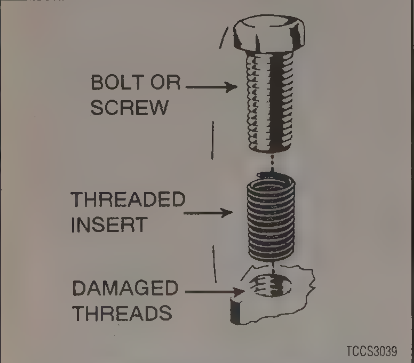


Fig. 1 Damaged bolt hole threads can be replaced with thread repair inserts

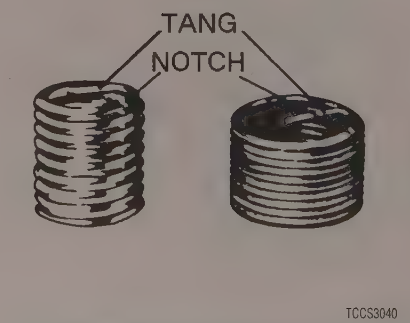


Fig. 2 Standard thread repair insert (left), and spark plug thread insert

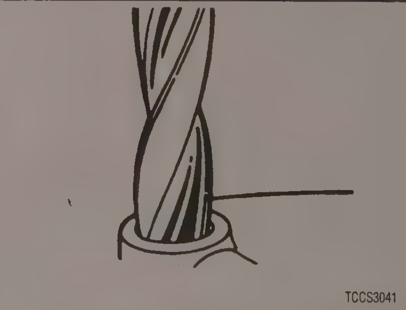


Fig. 3 Drill out the damaged threads with the specified drill. Be sure to drill completely through the hole or to the bottom of a blind hole

hole and installing a pre-wound insert making welding, plugging and oversize fasteners unnecessary.

Two types of thread repair inserts are usually supplied: a standard type for most inch coarse, inch fine, metric course and metric fine thread sizes and a spark lug type to fit most spark plug port sizes. Consult the individual manufacturer's catalog to determine exact applications. Typical thread repair kits will contain a selection of pre-wound threaded inserts, a tap (corresponding to the outside diameter threads of the insert) and an installation tool. Spark plug inserts usually differ because they require a tap equipped with pilot threads and a combined reamer/tap section. Most manufacturers also supply blister-packed thread repair inserts separately in addition to a master kit containing a variety of taps and inserts plus installation tools.

Before repairing to a threaded hole, remove any snapped, broken or damaged bolts or studs. Penetrating oil can be used to free frozen threads. The offending item can be removed with locking pliers or with a screw or stud extractor. After the hole is clear, the thread can be repaired, as shown in the series of accompanying illustrations.

✲✲ CAUTION

Please refer to Section 1 before discharging the compressor into a recovery station, or disconnecting any air conditioning lines. Damage to the air conditioning system or personal injury could result. Consult your local laws concerning refrigerant discharge and recycling. In many areas it may be illegal for anyone but a certified technician to service the A/C system. Always use an approved recovery station when discharging the air conditioning.

Checking Engine Compression

A noticeable lack of engine power, excessive oil consumption and/or poor fuel mileage measured over an extended period are all indicators of internal engine wear. Worn piston rings, scored or worn cylinder bores, blown head gaskets, sticking or burnt valves and worn valve seats are all possible culprits here. A check of each cylinder's compression will help you locate the problems.

As mentioned earlier, a screw-in type compression gauge is more accurate than the type you simply hold against the spark plug hole, although it takes slightly longer to use. It's worth it to obtain a more accurate reading. Follow the procedures below.

GASOLINE ENGINES

➧ See Figure 6

1. Warm up the engine to normal operating temperature.
2. Remove all the spark plugs.
3. Disconnect the high tension lead from the ignition coil.
4. Fully open the throttle either by operating the throttle body linkage by hand or by having an assistant floor the accelerator pedal.
5. Screw the compression gauge into the No. 1 spark plug hole until the fitting is snug.

✲✲ WARNING

Be careful not to cross-thread the plug hole. On aluminum cylinder heads use extra care, as the threads in these heads are easily ruined.

6. If you are not moving the linkage by hand, ask an assistant to depress the accelerator pedal fully on both carbureted and fuel injected vehicles. Then, while you read the compression gauge, ask the assistant to crank the engine two or three times in short bursts using the ignition switch.
7. Read the compression gauge at the end of each series of cranks, and record the highest of these readings. Repeat this procedure for each of the engine's cylinders. A cylinder's compression pressure is usually acceptable if it is no less than 80% of the highest cylinder's compression reading on the series of cranks.
8. If a cylinder is unusually low, pour a tablespoon of clean engine oil into the cylinder through the spark plug hole and repeat the compression test. If the compression comes up after adding the oil, it appears that the cylinder's piston rings or bore are damaged or worn. If the pressure remains low, the valves may not be seating properly (a valve job is needed), or the head gasket may be blown near that cylinder. If compression in any two adjacent cylinders is low, and if the addition of oil doesn't help the compression, there is probably leakage past the head gasket. Oil and coolant water in the combustion chamber can result from this problem. There may be evidence of water droplets on the engine dipstick when a head gasket has blown.

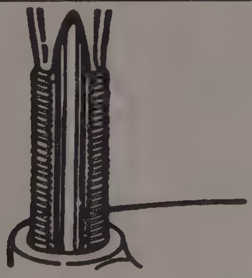
DIESEL ENGINES

Checking cylinder compression on diesel engines is basically the same procedure as on gasoline engines, except for the following:

- A special compression gauge adaptor which is suitable for diesel engines must be used, since these engines have much greater compression pressures.
- The injector tubes and injectors must be removed from each cylinder.

➡Don't forget to remove the washer underneath each injector. Otherwise, it may get lost when the engine is cranked.

- When fitting the compression gauge adaptor to the cylinder head, make sure that the bleeder valve (if equipped) is closed.
- When reinstalling the injector assemblies, install a new washer underneath each injector.



TCCS3042

Fig. 4 Using the kit, tap the hole in order to receive the thread insert. Keep the tap well oiled and back it out frequently to avoid clogging the threads

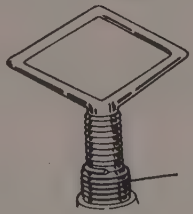


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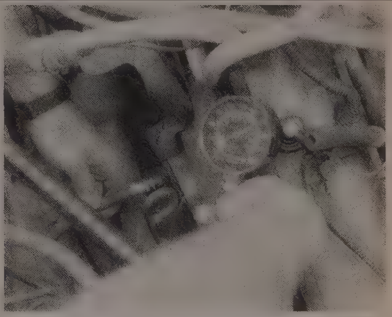
Fig. 5 Screw the threaded insert onto the installer tool until the tang engages the slot. Thread the insert into the hole until it is ¼ or ½ turn below the top surface, then remove the tool and break off the tang using a punch



TCCS3801

Fig. 6 A screw-in type compression gauge is more accurate and easier to use without an assistant

GENERAL ENGINE SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Fuel System Type	Net Horsepower @ rpm	Net Torque @ rpm (ft. lbs.)	Bore x Stroke (in.)	Com-pression Ratio	Oil Pressure @ rpm
1989	K	2.5 (2507)	TBI	96@4400	133@2800	3.45x4.09	8.9:1	35-65@2000
	X	3.9 (3916)	TBI	125@4000	195@4000	3.91x3.31	9.0:1	30-80@3000
	Y	5.2 (5211)	TBI	120@3600	245@1600	3.91x3.31	9.0:1	35-65@2000
	8	5.9 (5882)	DSL	160@2500	400@1700	4.02x4.72	17.5:1	30-70@2500
	Z	5.9 (5899)	TBI	193@4000	285@1600	4.00x3.58	8.1:1	30-80@3000
1990	K	2.5 (2507)	TBI	96@4400	133@2800	3.45x4.09	8.9:1	35-65@2000
	X	3.9 (3916)	TBI	125@4000	195@2000	3.91x3.31	9.1:1	30-80@3000
	Y	5.2 (5211)	TBI	170@4000	260@2000	3.91x3.31	9.2:1	30-80@3000
	8	5.9 (5882)	DSL	160@2500	400@1700	4.02x4.72	17.5:1	30-70@2500
	Z	5.9 (5899)	TBI	193@4000	292@4500	4.00x3.58	8.1:1	30-80@3000
	5	5.9 (5899)	TBI	193@4000	292@2400	4.00x3.58	8.1:1	30-80@3000
1991	K	2.5 (2507)	TBI	96@4400	133@2800	3.45x4.09	8.9:1	35-65@2000
	X	3.9 (3916)	TBI	125@4000	195@2000	3.91x3.31	9.1:1	30-80@3000
	Y	5.2 (5211)	TBI	170@4000	260@2000	3.91x3.31	9.2:1	30-80@3000
	8	5.9 (5882)	DSL	160@2500	400@1700	4.02x4.72	17.5:1	30-70@2500
	Z	5.9 (5899)	TBI	193@4000	292@2400	4.00x3.58	8.1:1	30-80@3000
	5	5.9 (5899)	TBI	193@4000	292@2400	4.00x3.58	8.1:1	30-80@3000
1992	K	2.5 (2507)	TBI	96@4400	133@2800	3.45x4.09	8.9:1	35-65@2000
	X	3.9 (3916)	MFI	175@4800	220@3200	3.91x3.31	9.1:1	30-80@3000
	Y	5.2 (5211)	MFI	170@4000	260@2000	3.91x3.31	9.2:1	30-80@3000
	8	5.9 (5882)	DSL	160@2500	400@1700	4.02x4.72	17.5:1	30-70@2500
	Z	5.9 (5889)	MFI	193@4000	292@2400	4.00x3.58	8.1:1	30-80@3000
	5	5.9 (5889)	MFI	193@4000	292@2400	4.00x3.58	8.1:1	30-80@3000
1993	K	2.5 (2507)	TBI	100@4800	135@2800	3.45x4.09	8.9:1	35-65@2000
	X	3.9 (3916)	MFI	175@4800	220@3200	3.91x3.31	9.1:1	30-80@3000
	Y	5.2 (5211)	MFI	230@4800	280@3200	3.91x3.31	9.1:1	30-80@3000
	8	5.9 (5882)	DSL	160@2500	400@1750	4.02x4.72	17.5:1	30-70@2500
	Z	5.9 (5899)	MFI	230@4000	325@2500	4.00x3.58	8.9:1	30-80@3000
	5	5.9 (5899)	MFI	230@4000	230@2800	4.00x3.58	8.9:1	30-80@3000
1994	K	2.5 (2507)	TBI	100@4800	135@2800	3.44x4.09	8.9:1	25-80@3000
	X	3.9 (3916)	MFI	175@4800	220@3200	3.91x3.31	9.1:1	30-80@3000
	Y	5.2 (5211)	MFI	220@4400	300@3200	3.91x3.31	9.1:1	30-80@3000
	C	5.9 (5882)	DSL	160@2500 [1]	400@1600 [2]	4.02x4.72	17.5:1	30@2500
	5	5.9 (5899)	MFI	230@4000	330@2800	4.00x3.58	8.9:1	30-80@3000
	Z	5.9 (5899)	MFI	230@4000	330@3200	4.00x3.58	8.9:1	30-80@3000
	W	8.0 (7997)	MFI	300@4000	450@2400	4.00x3.88	8.6:1	50-60@3000
1995	G	2.5 (2507)	TBI	100@4800	135@2800	3.45x4.09	8.9:1	25-80@3000
	X	3.9 (3916)	MFI	175@4800	220@3200	3.91x3.31	9.1:1	30-80@3000
	Y	5.2 (5211)	MFI	220@4400	300@3200	3.91x3.31	9.1:1	30-80@3000
	C	5.9 (5882)	DSL	160@2500 [1]	400@1600 [2]	4.02x4.72	17.5:1	30@2500
	5	5.9 (5899)	MFI	230@4000	330@2800	4.00x3.58	8.9:1	30-80@3000
	Z	5.9 (5899)	MFI	230@4000	330@3200	4.00x3.58	8.9:1	30-80@3000
	W	8.0 (7997)	MFI	300@4000	450@2400	4.00x3.88	8.6:1	50-60@3000

88473C00

GENERAL ENGINE SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Fuel System Type	Net Horsepower @ rpm	Net Torque @ rpm (ft. lbs.)	Bore x Stroke (in.)	Com-pression Ratio	Oil Pressure @ rpm
1996	G	2.5 (2507)	MFI	100@4800	135@2800	3.45x4.09	8.9:1	25-80@3000
	X	3.9 (3916)	MFI	175@4800	220@3200	3.91x3.31	9.1:1	30-80@3000
	Y	5.2 (5211)	MFI	220@4400	300@3200	3.91x3.31	9.1:1	30-80@3000
	C	5.9 (5882)	DSL	160@2500 [1]	400@1600 [2]	4.02x4.72	17.5:1	30@2500
	5	5.9 (5899)	MFI	230@4000	330@2800	4.00x3.58	8.9:1	30-80@3000
	Z	5.9 (5899)	MFI	230@4000	330@3200	4.00x3.58	8.9:1	30-80@3000
	W	8.0 (7997)	MFI	300@4000	450@2400	4.00x3.88	8.6:1	50-60@3000

BC - Barrel carburetor
TBI - Throttle Body Fuel Injection
DSL - Diesel
MFI - Multi-port Fuel Injection

[1] Manual transmission 175@2500

[2] Manual transmission 430@1600

88473C01

VALVE SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Seat Angle (deg.)	Face Angle (deg.)	Spring Test Pressure (lbs. @ in.)	Spring Installed Height (in.)	Stem-to-Guide Clearance (in.) Intake	Stem-to-Guide Clearance (in.) Exhaust	Stem Diameter (in.) Intake	Stem Diameter (in.) Exhaust
1989	K	2.5 (2507)	45	45	115@1.65	1.65	0.0009-0.0047	0.0030-0.0047	0.3124	0.3103
	X	3.9 (3916)	45	45	[2]	[4]	0.001-0.002	0.002-0.004	0.372-0.373	0.371-0.372
	Y	5.2 (5211)	45	45	[2]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	W	5.9 (5899)	45	45	[2]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	Z	5.9 (5899)	45	45	[2]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
1990	K	2.5 (2507)	45	45	115@1.65	1.65	0.0009-0.0047	0.0030-0.0047	0.3124	0.3103
	X	3.9 (3916)	45	45	[2]	[4]	0.001-0.002	0.002-0.004	0.372-0.373	0.371-0.372
	Y	5.2 (5211)	45	45	[2]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	5	5.9 (5899)	45	45	[2]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	W	5.9 (5899)	45	45	[2]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	Z	5.9 (5899)	45	45	[2]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
1991	K	2.5 (2507)	45	45	115@1.65	1.65	0.0009-0.0047	0.0030-0.0047	0.3124	0.3103
	X	3.9 (3916)	45	45	[3]	[4]	0.001-0.003	0.002-0.004	0.0372-0.373	0.371-0.372
	Y	5.2 (5211)	45	45	[3]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	5	5.9 (5899)	45	45	[3]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	W	5.9 (5899)	45	45	[3]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	Z	5.9 (5899)	45	45	[3]	[4]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
1992	K	2.5 (2507)	45	45	115@1.65	1.65	0.0009-0.0047	0.0030-0.0047	0.3124	0.3103
	X	3.9 (3916)	44.25-44.75	43.25-43.75	[3]	[5]	0.001-0.002	0.002-0.004	0.313	0.313
	Y	5.2 (5211)	44.25-44.75	43.25-43.75	[3]	[5]	0.001-0.003	0.002-0.004	0.313	0.313
	5	5.9 (5899)	45	45	[6]	[5]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	Z	5.9 (5899)	45	45	[6]	[5]	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372

88473C02

VALVE SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Seat Angle (deg.)	Face Angle (deg.)	Spring Test Pressure (lbs. @ in.)	Spring Installed Height (in.)	Stem-to-Guide Clearance (in.) Intake	Stem-to-Guide Clearance (in.) Exhaust	Stem Diameter (in.) Intake	Stem Diameter (in.) Exhaust
1993	K	2.5 (2507)	45	45	115@1.65	1.65	0.0009-0.0047	0.0030-0.0047	0.3124	0.3103
	X	3.9 (3916)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312
	Y	5.2 (5211)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312
	5	5.9 (5899)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	Z	5.9 (5899)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
1994	K	2.5 (2507)	45	45	115@1.65	1.65	0.0009-0.0047	0.0030-0.0047	0.3124	0.3103
	X	3.9 (3916)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312
	Y	5.2 (5211)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312
	5	5.9 (5899)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	Z	5.9 (5899)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	W	8.0 (7997)	44.5	45	81-89@ 1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312
1995	G	2.5 (2507)	45	45	115@1.65	1.65	0.0009-0.0026	0.0030-0.0047	0.3124	0.3103
	X	3.9 (3916)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312
	Y	5.2 (5211)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312
	C	5.9 (5882)	[1]	[1]	81@1.94	2.36	0.002-0.006	0.002-0.006	0.313-0.314	0.313-0.314
	5	5.9 (5899)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	Z	5.9 (5899)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	W	8.0 (7997)	44.5	45	81-89@ 1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312

88473C03

VALVE SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Seat Angle (deg.)	Face Angle (deg.)	Spring Test Pressure (lbs. @ in.)	Spring Installed Height (in.)	Stem-to-Guide Clearance (in.)		Stem Diameter (in.)	
							Intake	Exhaust	Intake	Exhaust
1996	G	2.5 (2507)	45	45	115@1.65	1.65	0.0009-0.0026	0.0030-0.0047	0.3124	0.3103
	X	3.9 (3916)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312
	Y	5.2 (5211)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312
	C	5.9 (5882)	[1]	[1]	81@1.94	2.36	0.002-0.006	0.002-0.006	0.313-0.314	0.313-0.314
	5	5.9 (5899)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	Z	5.9 (5899)	44.25-44.75	43.25-43.75	85@1.64	1.64	0.001-0.003	0.002-0.004	0.372-0.373	0.371-0.372
	W	8.0 (7997)	44.5	45	81-89@1.64	1.64	0.001-0.003	0.001-0.003	0.311-0.312	0.311-0.312

[1] Intake: 30 degrees; Exhaust: 45 degrees

[2] Intake: 170-184@ 1.3125
Exhaust: 181-197@ 1.0625

[3] Intake: 78-88 @ 1.688 in.
Exhaust: 80-90 @ 1.203 in.

[4] Intake: 1.625-1.688; Exhaust: 1.453-1.516

[5] Intake: 1.688; Exhaust: 1.203

[6] Intake: 78-88 @ 1.688 in.
Exhaust: 80-90 @ 1.484 in.

88473C04

CAMSHAFT SPECIFICATIONS

All measurements given in inches.

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Journal Diameter					Elevation		Bearing Clearance	Camshaft End-Play
			1	2	3	4	5	In.	Ex.		
1989	K	2.5 (2507)	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	NA	NA	NA	0.005-0.020
	X	3.9 (3916)	1.998-1.999	1.967-1.968	1.951-1.952	1.561-1.562	-	0.373 [1]	0.400 [1]	0.001-0.005	0.002-0.0010
	Y	5.2 (5211)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.373 [1]	0.400 [1]	0.001-0.005	0.002-0.010
	W	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
	Z	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
1990	K	2.5 (2507)	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	NA	NA	NA	0.005-0.020
	X	3.9 (3916)	1.998-1.999	1.967-1.968	1.951-1.952	1.561-1.562	-	0.373 [1]	0.400 [1]	0.001-0.005	0.002-0.010
	Y	5.2 (5211)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.373 [1]	0.400 [1]	0.001-0.005	0.002-0.010
	W	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.9520	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
	5	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
	Z	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
1991	K	2.5 (2507)	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	NA	NA	NA	0.005-0.020
	X	3.9 (3916)	1.998-1.999	1.967-1.968	1.951-1.952	1.561-1.562	-	0.373 [1]	0.400 [1]	0.001-0.005	0.002-0.010
	Y	5.2 (5211)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.400 [1]	0.400 [1]	0.001-0.005	0.002-0.010
	8	5.9 (5882)	2.125	2.125	2.125	2.125	-	1.852 [1]	1.841 [1]	0.001-0.005	0.006-0.010
	5	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
	W	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
	Z	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010

88473C05

CAMSHAFT SPECIFICATIONS

All measurements given in inches.

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Journal Diameter 1	2	3	4	5	Elevation In.	Ex.	Bearing Clearance	Camshaft End-Play
1992	K	2.5 (2507)	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	NA	NA	NA	0.005-0.020
	X	3.9 (3916)	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	-	0.373 [1]	0.0400 [1]	0.001-0.005	0.002-0.010
	Y	5.2 (5211)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.373 [1]	0.400 [1]	0.001-0.005	0.002-0.010
	8	5.9 (5882)	2.125	2.125	2.125	2.125	-	1.852 [2]	1.841 [2]	0.001-0.005	0.006-0.010
	5	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
	Z	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
1993	K	2.5 (2507)	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	NA	NA	NA	0.005-0.013
	X	3.9 (3916)	1.998-1.999	1.982-1.983	1.951-1.952	1.561-1.562	-	0.432 [1]	0.432 [1]	0.001-0.005	0.002-0.010
	Y	5.2 (5211)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.432 [1]	0.432	0.001-0.005	0.002-0.010
	8	5.9 (5882)	2.125	2.125	2.125	2.125	-	1.852 [2]	1.841 [2]	0.001-0.005	0.006-0.010
	5	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
	Z	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410 [1]	0.001-0.005	0.002-0.010
1994	K	2.5 (2507)	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	1.375-1.376	NA	NA	NA	0.005-0.013
	X	3.9 (3916)	1.998-1.999	1.982-1.983	1.951-1.952	1.561-1.562	-	0.432 [1]	0.432 [1]	0.001-0.005	0.002-0.010
	Y	5.2 (5211)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.432 [1]	0.432 [1]	0.001-0.005	0.002-0.010
	C	5.9 (5882)	2.125	2.125	2.125	2.125	-	1.398 [2]	1.398 [2]	0.001-0.005	0.006-0.010
	5	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410	0.410	0.001-0.005	0.002-0.010
	Z	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410	0.410	0.001-0.005	0.002-0.010
	W	8.0 (7997)	2.091-2.092	2.074-2.075	2.059-2.060	2.043-2.044	2.027-2.028 [3]	0.390	0.407	0.001-0.003 [4]	0.005-0.015

88473C06

CAMSHAFT SPECIFICATIONS

All measurements given in inches.

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Journal Diameter 1	2	3	4	5	Elevation In.	Ex.	Bearing Clearance	Camshaft End-Play
1995	G	2.5 (2507)	1.375-1.3760	1.375-1.3760	1.375-1.3760	1.375-1.3760	1.375-1.3760	NA	NA	NA	0.005-0.013
	X	3.9 (3916)	1.998-1.999	1.982-1.983	1.951-1.952	1.561-1.562	-	0.432 [1]	0.432 [1]	0.001-0.005	0.002-0.010
	Y	5.2 (5211)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.432 [1]	0.432 [1]	0.001-0.005	0.002-0.010
	C	5.9 (5882)	2.125	2.125	2.125	2.125	-	1.398 [2]	1.398 [2]	0.001-0.005	0.006-0.010
	5	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410	0.410	0.001-0.005	0.002-0.010
	Z	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410	0.001-0.005	0.002-0.010
	W	8.0 (7997)	2.091-2.092	2.074-2.075	2.059-2.060	2.043-2.044	2.027-2.028 [3]	0.390	0.407	0.001-0.003 [4]	0.005-0.015
1996	G	2.5 (2507)	1.375-1.3760	1.375-1.3760	1.375-1.3760	1.375-1.3760	1.375-1.3760	NA	NA	NA	0.005-0.013
	X	3.9 (3916)	1.998-1.999	1.982-1.983	1.951-1.952	1.561-1.562	-	0.432 [1]	0.432 [1]	0.001-0.005	0.002-0.010
	Y	5.2 (5211)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.432 [1]	0.432 [1]	0.001-0.005	0.002-0.010
	C	5.9 (5882)	2.125	2.125	2.125	2.125	-	1.398 [2]	1.398 [2]	0.001-0.005	0.006-0.010
	5	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410	0.410	0.001-0.005	0.002-0.010
	Z	5.9 (5899)	1.998-1.999	1.982-1.983	1.967-1.968	1.951-1.952	1.561-1.562	0.410 [1]	0.410	0.001-0.005	0.002-0.010
	W	8.0 (7997)	2.091-2.092	2.074-2.075	2.059-2.060	2.043-2.044	2.027-2.028 [3]	0.390	0.407	0.001-0.003 [4]	0.005-0.015

NA - Not Available

[1] Lift at valve

[2] Minimum diameter at peak of lobe

[3] Journal No. 6: 1.917-1.918

[4] No. 2: 0.0015-0.0035

88473C07

CRANKSHAFT AND CONNECTING ROD SPECIFICATIONS

All measurements are given in inches.

		Engine	Crankshaft				Connecting Rod		
Year	Engine ID/VIN	Displacement Liters (cc)	Main Brg. Journal Dia.	Main Brg. Oil Clearance	Shaft End-play	Thrust on No.	Journal Diameter	Oil Clearance	Side Clearance
1989	K	2.5 (2507)	2.3620-2.3630	0.0003-0.0031	0.002-0.007	3	1.968-1.969	0.0008-0.0034	0.005-0.013
	X	3.9 (3916)	2.5000-2.5010	[1]	0.002-0.010	2	2.124-2.125	0.0005-0.0022	0.006-0.014
	Y	5.2 (5211)	2.4995-2.5005	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	8	5.9 (5882)	3.2662 [2]	0.0047	0.005-0.012	6	2.714 [2]	0.0035	0.004-0.012
	W	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	Z	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
1990	K	2.5 (2507)	2.3620-2.3630	0.0003-0.0031	0.002-0.007	3	1.968-1.969	0.0008-0.0034	0.005-0.013
	X	3.9 (3916)	2.5000-2.5010	[1]	0.002-0.010	2	2.124-2.125	0.0005-0.0022	0.006-0.014
	Y	5.2 (5211)	2.4995-2.5005	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	8	5.9 (5882)	3.2662 [2]	0.0047	0.005-0.012	6	2.714 [2]	0.0035	0.004-0.012
	5	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	W	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	Z	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
1991	K	2.5 (2507)	2.3620-2.3630	0.0003-0.0031	0.002-0.007	3	1.968-1.969	0.0008-0.0034	0.005-0.013
	X	3.9 (3916)	2.5000-2.5010	[1]	0.002-0.010	2	2.124-2.125	0.0005-0.0022	0.006-0.014
	Y	5.2 (5211)	2.4995-2.5005	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	8	5.9 (5882)	3.2662 [2]	0.0047	0.005-0.012	6	2.714 [2]	0.0035	0.004-0.012
	5	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	W	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	Z	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.010	3	2.124-2.125	0.0005-0.0022	0.006-0.014

88473C14

CRANKSHAFT AND CONNECTING ROD SPECIFICATIONS

All measurements are given in inches.

		Engine	Crankshaft				Connecting Rod		
Year	Engine ID/VIN	Displacement Liters (cc)	Main Brg. Journal Dia.	Main Brg. Oil Clearance	Shaft End-play	Thrust on No.	Journal Diameter	Oil Clearance	Side Clearance
1992	K	2.5 (2507)	2.3620-2.3630	0.0004-0.0028	0.002-0.007	3	1.968-1.969	0.0008-0.0034	0.005-0.013
	X	3.9 (3916)	2.5000-2.5010	[1]	0.002-0.007	2	2.124-2.125	0.0005-0.0022	0.006-0.014
	Y	5.2 (5211)	2.4995-2.5005	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	8	5.9 (5882)	3.2662 [2]	0.0047	0.005-0.012	6	2.714 [2]	0.0035	0.004-0.012
	5	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	Z	5.9 (5899)	2.8095- [1] 2.8105	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
1993	K	2.5 (2507)	2.3620-2.3630	0.0004-0.0028	0.002-0.007	3	1.9680-1.9690	0.0008-0.0034	0.005-0.013
	X	3.9 (3916)	2.5000-2.5010	[1]	0.002-0.007	2	2.124-2.125	0.0005-0.0022	0.006-0.014
	Y	5.2 (5211)	2.4995-2.5005	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	8	5.9 (5882)	3.2662 [2]	0.0047	0.005-0.012	6	2.714 [2]	0.0035	0.004-0.012
	5	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	Z	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
1994	K	2.5 (2507)	2.3620-2.3630	0.0004-0.0028	0.002-0.007	3	1.9680-1.9690	0.0008-0.0034	0.005-0.013
	X	3.9 (3916)	2.5000-2.5010	[1]	0.002-0.007	2	2.124-2.125	0.0005-0.0022	0.006-0.014
	Y	5.2 (5211)	2.4995-2.5005	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	C	5.9 (5882)	3.2662 [2]	0.0047	0.004-0.017	6	2.714 [2]	0.0035	0.004-0.012
	A	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	5	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	Z	5.9 (5899)	2.8095-2.8105	[1]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	W	8.0 (7997)	2.9995-3.0005	0.0002-0.0023	0.0020-0.017	3	2.124-2.125	0.0002-0.0029	0.010-0.018

88473C15

CRANKSHAFT AND CONNECTING ROD SPECIFICATIONS

All measurements are given in inches.

		Engine	Crankshaft				Connecting Rod		
Year	Engine ID/VIN	Displacement Liters (cc)	Main Brg. Journal Dia.	Main Brg. Oil Clearance	Shaft End-play	Thrust on No.	Journal Diameter	Oil Clearance	Side Clearance
1995	G	2.5 (2507)	2.3620-2.3630	0.0003-0.0031	0.002-0.007	3	1.9680-1.9690	0.0008-0.0034	0.005-0.013
	X	3.9 (3916)	2.5000-2.5010	[3]	0.002-0.007	2	2.124-2.125	0.0005-0.0022	0.006-0.014
	Y	5.2 (5211)	2.4995-2.5005	[3]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	C	5.9 (5882)	3.2662 [2]	0.0047	0.004-0.017	6	2.714 [2]	0.0035	0.004-0.012
	5	5.9 (5899)	2.8095-2.8105	[3]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	Z	5.9 (5899)	2.8095-2.8105	[3]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	W	8.0 (7997)	2.9995-3.0005	0.0002-0.0023	0.003-0.012	3	2.124-2.125	0.0002-0.0029	0.010-0.018
1996	G	2.5 (2507)	2.3620-2.3630	0.0003-0.0031	0.002-0.007	3	1.9680-1.9690	0.0008-0.0034	0.005-0.013
	X	3.9 (3916)	2.5000-2.5010	[3]	0.002-0.007	2	2.124-2.125	0.0005-0.0022	0.006-0.014
	Y	5.2 (5211)	2.4995-2.5005	[3]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	C	5.9 (5882)	3.2662 [2]	0.0047	0.004-0.017	6	2.714 [2]	0.0035	0.004-0.012
	5	5.9 (5899)	2.8095-2.8105	[3]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	Z	5.9 (5899)	2.8095-2.8105	[3]	0.002-0.007	3	2.124-2.125	0.0005-0.0022	0.006-0.014
	W	8.0 (7997)	2.9995-3.0005	0.0002-0.0023	0.003-0.012	3	2.124-2.125	0.0002-0.0029	0.010-0.018

[1] 0.0005-0.0015 on No. 1
0.0005-0.0020 on Nos. 2-4

[2] Maximum wear limit

[3] No. 1: 0.0005-0.0015
Nos. 2-4, and 5, if applicable: 0.0005-0.0020

88473C16

PISTON AND RING SPECIFICATIONS

All measurements are given in inches.

		Engine		Ring Gap			Ring Side Clearance		
Year	Engine ID/VIN	Displacement Liters (cc)	Piston Clearance	Top Compression	Bottom Compression	Oil Control	Top Compression	Bottom Compression	Oil Control
1989	K	2.5 (2507)	0.0005-0.0015	0.010-0.021	0.011-0.021	0.015-0.035	0.0015-0.0031	0.0002-0.0080	NA
	X	3.9 (3916)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	Y	5.2 (5211)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	8	5.9 (5882)	NA	0.016-0.028	0.010-0.021	0.010-0.021	0.0030-0.0060	0.0030-0.0060	0.0020-0.0050
	5	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	W	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	Z	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
1990	K	2.5 (2507)	0.0005-0.0015	0.010-0.021	0.011-0.021	0.015-0.035	0.0015-0.0031	0.0002-0.0080	NA
	X	3.9 (3916)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	Y	5.2 (5211)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	8	5.9 (5882)	NA	0.016-0.028	0.010-0.021	0.010-0.021	0.0030-0.0060	0.0030-0.0060	0.0020-0.0050
	5	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	W	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	Z	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
1991	K	2.5 (2507)	0.0005-0.0015	0.010-0.021	0.011-0.021	0.015-0.035	0.0015-0.0031	0.0022-0.0080	NA
	X	3.9 (3916)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	Y	5.2 (5211)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	8	5.9 (5882)	NA	0.016-0.028	0.010-0.021	0.010-0.021	0.0030-0.0060	0.0030-0.0060	0.0020-0.0050
	5	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	W	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050
	Z	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.0002-0.0050

88473C17

PISTON AND RING SPECIFICATIONS

All measurements are given in inches.

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Piston Clearance	Ring Gap Top Compression	Ring Gap Bottom Compression	Ring Gap Oil Control	Ring Side Clearance Top Compression	Ring Side Clearance Bottom Compression	Ring Side Clearance Oil Control
1992	K	2.5 (2507)	0.0005-0.0015	0.010-0.021	0.011-0.021	0.015-0.035	0.0015-0.0031	0.0002-0.0080	NA
	X	3.9 (3916)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.005
	Y	5.2 (5211)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.005
	8	5.9 (5882)	NA	0.016-0.028	0.010-0.021	0.010-0.021	0.0030-0.0060	0.0030-0.0060	0.0020-0.0050
	5	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.005
	Z	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.005
1993	K	2.5 (2507)	0.0005-0.0015	0.010-0.020	0.011-0.021	0.015-0.055	0.0015-0.0031	0.0015-0.0037	NA
	X	3.9 (3916)	0.0003-0.0008	0.010-0.020	0.010-0.020	0.010-0.050	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	Y	5.2 (5211)	0.0003-0.0008	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	8	5.9 (5882)	NA	0.016-0.028	0.010-0.021	0.010-0.021	0.0030-0.0060	0.0030-0.0060	0.0020-0.0050
	5	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	Z	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.008
1994	K	2.5 (2507)	0.0005-0.0015	0.010-0.020	0.011-0.021	0.015-0.055	0.0015-0.0031	0.0015-0.0037	NA
	X	3.9 (3916)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.010-0.050	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	Y	5.2 (5211)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.010-0.050	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	C	5.9 (5882)	NA	0.016-0.028	0.010-0.021	0.010-0.021	0.0030-0.0060	0.0030-0.0060	0.002-0.005
	5	5.9 (5899)	0.0005-0.0015	0.012-0.022	0.022-0.031	0.015-0.055	0.0016-0.0033	0.0016-0.0033	0.002-0.008
	A	5.9 (5899)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0016-0.0033	0.0016-0.0033	0.002-0.008
	Z	5.9 (5899)	0.0005-0.0015	0.012-0.022	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	W	8.0 (7997)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0029-0.0038	0.0029-0.0038	0.0073-0.0097

88473C18

PISTON AND RING SPECIFICATIONS

All measurements are given in inches.

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Piston Clearance	Ring Gap Top Compression	Ring Gap Bottom Compression	Ring Gap Oil Control	Ring Side Clearance Top Compression	Ring Side Clearance Bottom Compression	Ring Side Clearance Oil Control
1995	G	2.5 (2507)	0.0005-0.0015	0.010-0.020	0.011-0.021	0.015-0.055	0.0015-0.0031	0.0015-0.0037	NA
	X	3.9 (3916)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.010-0.050	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	Y	5.2 (5211)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.010-0.050	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	C	5.9 (5882)	NA	0.016-0.028	0.010-0.021	0.010-0.021	0.0030-0.0060	0.0030-0.0060	0.002-0.005
	5	5.9 (5899)	0.0005-0.0015	0.012-0.022	0.022-0.031	0.015-0.055	0.0016-0.0033	0.0016-0.0033	0.002-0.008
	Z	5.9 (5899)	0.0005-0.0015	0.012-0.022	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	W	8.0 (7997)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0029-0.0038	0.0029-0.0038	0.0073-0.0097
1996	G	2.5 (2507)	0.0005-0.0015	0.010-0.020	0.011-0.021	0.015-0.055	0.0015-0.0031	0.0015-0.0037	NA
	X	3.9 (3916)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.010-0.050	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	Y	5.2 (5211)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.010-0.050	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	C	5.9 (5882)	NA	0.016-0.028	0.010-0.021	0.010-0.021	0.0030-0.0060	0.0030-0.0060	0.002-0.005
	5	5.9 (5899)	0.0005-0.0015	0.012-0.022	0.022-0.031	0.015-0.055	0.0016-0.0033	0.0016-0.0033	0.002-0.008
	Z	5.9 (5899)	0.0005-0.0015	0.012-0.022	0.010-0.020	0.015-0.055	0.0015-0.0030	0.0015-0.0030	0.002-0.008
	W	8.0 (7997)	0.0005-0.0015	0.010-0.020	0.010-0.020	0.015-0.055	0.0029-0.0038	0.0029-0.0038	0.0073-0.0097

NA - Not Available

88473C19

TORQUE SPECIFICATIONS

All readings in ft. lbs.

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Cylinder Head Bolts	Main Bearing Bolts	Rod Bearing Bolts	Crankshaft Damper Bolts	Flywheel Bolts	Manifold		Spark Plugs	Lug Nut
								Intake	Exhaust		
1989	K	2.5 (2507)	[1]	[2]	[3]	50	70	17	17	26	95
	X	3.9 (3916)	105	85	45	135	55	45	[4]	30	[5]
	Y	5.2 (5211)	105	85	45	100	55	40	[4]	30	[5]
	8	5.9 (5882)	[6]	[7]	[8]	92	101	-	32	-	[5]
	W	5.9 (5899)	105	85	45	100	55	40	[4]	30	[5]
	Z	5.9 (5899)	105	85	45	100	55	40	[4]	30	[5]
1990	K	2.5 (2507)	[1]	[2]	[3]	50	70	17	17	26	95
	X	3.9 (3916)	105	85	45	135	55	40	[4]	30	[5]
	Y	5.2 (5211)	105	85	45	100	55	40	[4]	30	[5]
	8	5.9 (5882)	[6]	[7]	[8]	92	101	-	32	-	[5]
	5	5.9 (5899)	105	85	45	100	55	40	[4]	30	[5]
	Z	5.9 (5899)	104	85	45	100	55	40	[4]	30	[5]
1991	K	2.5 (2507)	[1]	[2]	[3]	50	70	17	17	26	95
	X	3.9 (3916)	105	85	45	135	55	[9]	[4]	30	[5]
	Y	5.2 (5211)	105	85	45	135	55	[9]	[4]	30	[5]
	8	5.9 (5882)	[6]	[10]	[8]	92	101	-	32	-	[5]
	5	5.9 (5899)	105	85	45	135	55	40	[4]	30	[5]
	W	5.9 (5899)	105	85	45	135	55	40	[4]	30	[5]
	Z	5.9 (5899)	105	85	45	135	55	40	[4]	30	[5]
1992	K	2.5 (2507)	[1]	[2]	[3]	50	70	17	17	26	95
	X	3.9 (3916)	105	85	45	135	55	[9]	[4]	30	[5]
	Y	5.2 (5211)	105	85	45	135	55	[9]	[4]	30	[5]
	8	5.9 (5882)	[11]	[12]	[8]	92	101	-	32	-	[5]
	5	5.9 (5899)	105	85	45	135	55	40	[4]	30	[5]
	Z	5.9 (5899)	105	85	45	135	55	40	[4]	30	[5]
1993	K	2.5 (2507)	[1]	[2]	[3]	50	70	17	17	26	95
	X	3.9 (3916)	105	85	45	135	55	45	[4]	30	[5]
	Y	5.2 (5211)	105	85	45	135	55	40	[4]	30	[5]
	8	5.9 (5882)	[11]	[7]	[8]	92	101	-	32	-	[5]
	5	5.9 (5899)	105	85	45	135	55	40	[4]	30	[5]
	Z	5.9 (5899)	105	85	45	135	55	40	[4]	30	[5]
1994	K	2.5 (2507)	[1]	[2]	[3]	85	70	17	17	20	95
	X	3.9 (3916)	[13]	85	45	135	55	[14]	25	30	[15]
	Y	5.2 (5211)	[13]	85	45	135	55	[14]	25	30	[15]
	C	5.9 (5882)	[6]	[7]	[8]	92	101	[16]	32	-	[15]
	5	5.9 (5899)	[13]	85	45	135	55	[14]	25	30	[15]
	Z	5.9 (5899)	[13]	85	45	135	55	[14]	25	30	[15]
	W	8.0 (7997)	[13]	85	45	135	55	[17]	16	30	[15]
1995	G	2.5 (2507)	[1]	[2]	[3]	85	70	17	17	20	95
	X	3.9 (3916)	[13]	85	45	135	55	[14]	25	30	[15]
	Y	5.2 (5211)	[13]	85	45	135	55	[14]	25	30	[15]
	C	5.9 (5882)	[6]	[7]	[8]	92	101	[16]	32	-	[15]
	5	5.9 (5899)	[13]	85	45	135	55	[14]	25	30	[15]
	Z	5.9 (5899)	[13]	85	45	135	55	[14]	25	30	[15]
	W	8.0 (7997)	[13]	85	45	135	55	[17]	16	30	[15]

88473C20

TORQUE SPECIFICATIONS

All readings in ft. lbs.

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Cylinder Head Bolts	Main Bearing Bolts	Rod Bearing Bolts	Crankshaft Damper Bolts	Flywheel Bolts	Manifold		Spark Plugs	Lug Nut
								Intake	Exhaust		
1996	G	2.5 (2507)	[1]	[2]	[3]	85	70	17	17	20	95
	X	3.9 (3916)	[13]	85	45	135	55	[14]	25	30	[15]
	Y	5.2 (5211)	[13]	85	45	135	55	[14]	25	30	[15]
	C	5.9 (5882)	[6]	[7]	[8]	92	101	[16]	32	-	[15]
	5	5.9 (5899)	[13]	85	45	135	55	[14]	25	30	[15]
	Z	5.9 (5899)	[13]	85	45	135	55	[14]	25	30	[15]
	W	8.0 (7997)	[13]	85	45	135	55	[17]	16	30	[15]

[1] Step 1: 45 ft. lbs.
Step 2: 65 ft. lbs.
Step 3: 65 ft. lbs.
Step 4: Plus 1/4 turn

[2] Step 1: 30 ft. lbs.
Step 2: Plus 1/4 turn

[3] Step 1: 40 ft. lbs.
Step 2: Plus 1/4 turn

[4] Bolts: 20 ft. lbs.
Nuts: 15 ft. lbs.

[5] 1/2x20 stud: 85-110 ft. lbs.
5/8x18 stud with cone nut: 175-225 ft. lbs.
5/8x18 stud with flanged nut: 300-350 ft. lbs.

[6] Step 1: 29 ft. lbs.
Step 2: 62 ft. lbs.
Step 3: 93 ft. lbs.

[7] Step 1: 45 ft. lbs.
Step 2: 88 ft. lbs.
Step 3: 129 ft. lbs.

[8] Step 1: 26 ft. lbs.
Step 2: 51 ft. lbs.
Step 3: 73 ft. lbs.

[9] Step 1: 72 in. lbs.
Step 2: 12 ft. lbs.
Step 3: Recheck all bolts

[10] Step 1: 29 ft. lbs.
Step 2: 62 ft. lbs.
Step 3: 129 ft. lbs.

[11] All bolts: 66 ft. lbs.
Long bolts: 89 ft. lbs.
All bolts [illegible] additional 1/4 turn

[12] Step 1: 45 ft. lbs.
Step 2: 88 ft. lbs.
Step 3: 129 ft. lbs.

[13] Step 1: 50 ft. lbs.
Step 2: 105 ft. lbs.

[14] Step 1: Tighten bolts 1 and 2 (V6) or 1 through 4 (V8), in increments of 12 in. lbs. to 72 in-lbs.
Step 2: Tighten bolts 3 through 12 (V6) or 5 through 12 (V8), in sequence, to 72 in. lbs.
Step 3: Check to make sure that all bolts are tightened to 72 in. lbs.
Step 4: Tighten all bolts, in sequence, to 144 in. lbs.
Step 5: Check to make sure all bolts are tightened to 144 in. lbs.

[15] 5 stud wheel: 95 ft. lbs.
8 stud wheel: 135 ft. lbs.
8 stud dual wheel: 145 ft. lbs.

[16] Intake manifold cover bolts: 18 ft. lbs.

[17] Lower intake: 40 ft. lbs.
Upper intake: 16 ft. lbs.

88473C21

Engine

REMOVAL & INSTALLATION

Gasoline Engine

EXCEPT DAKOTA

1. Scribe hood hinge outlines on the hood and remove the hood from the vehicle. Disconnect the battery.
2. Drain the coolant from the radiator and engine block.
3. Drain the engine oil.

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

4. Remove the air cleaner.
5. Remove the starter.

CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

6. Depressurize the fuel injection system.
7. Have the air conditioning refrigerant properly discharged at a reputable repair shop.
8. If equipped, remove the transmission oil cooler.
9. Disconnect both radiator and heater hoses. Remove the radiator and set the fan shroud aside.
10. Remove the power steering pump and air pump with the hoses attached and lay them aside.
11. Remove the washer bottle.
12. Disconnect and tag the vacuum lines.
13. Remove the A/C compressor and lay it aside with the hoses connected, if enough slack exists. If not, disconnect the A/C hoses.
14. On manual transmission models, remove the shift lever.
15. Disconnect the throttle linkage and all electrical connection to the engine sensors. Tag all electrical connections before disconnecting.
16. Remove the alternator, fan, pulley and drive belt(s).
17. Remove the distributor cap and wires.
18. Remove and plug the fuel line.
19. Disconnect the exhaust pipe at the manifold.
20. On automatic transmission models, remove the bell housing bolts and inspection plate. Attach a C-clamp on the front bottom of the transmission torque converter housing to prevent the torque converter from coming out.
21. Remove the retaining bolts from the torque converter drive plate. Mark the converter and drive plate to aid in reassembly.
22. Remove the driveshaft and engine rear support.
23. Support the transmission with a suitable transmission jack.
24. Remove the transmission.
25. Raise the rear of the engine approximately 2 in. (51mm) and remove the clutch or drive plate and the flywheel.
26. Using a boom hoist attached to the engine with the shortest hook-up possible, take up all tension and support the engine.

WARNING

Do not lift the engine by the intake manifold.

27. Remove the engine front mounts and insulators.
28. Carefully remove the engine from the vehicle. Lift slowly and watch for any snagged or missed connections. Mount the engine on a suitable engine stand for further disassembly or service work.
29. Installation is the reverse of removal. Secure all components to specifications.
30. On the V10 engine, prime the oil pump by filling the J-trap of the front timing cover with oil and quickly installing an oil-filled filter in place just as the oil is pouring out of the J-trap.
31. Fill the cooling system. Connect the battery.
32. Check all fluid levels and perform all tune-up adjustments if the engine was rebuilt.
33. Take the vehicle back to the air conditioning service facility and have them properly evacuate and charge the air conditioning system.

DAKOTA

1. Relieve the fuel system pressure as described in Section 5.
2. Disconnect the negative battery cable from the battery and from the engine.
3. Scribe hood hinge outlines on the hood and remove the hood from the vehicle. Remove the hood and the oil dipstick.

CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

4. Raise the vehicle and support safely, Drain the engine oil and coolant. Remove the lower radiator hose.
5. Remove the starter. Remove the engine to transmission struts, if equipped.

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

6. Remove the exhaust pipe from the exhaust manifold(s).
7. If the vehicle is equipped with a manual transmission, remove the transmission and all related parts.
8. If the vehicle is equipped with an automatic transmission, remove the inspection plate, matchmark the flexplate to the converter, remove the torque converter bolts and push the torque converter backwards as far as it will go.
9. Remove the engine mount lower nuts.
10. If the vehicle is equipped with 4WD:
    a. On the left side, remove the two bolts attaching the bracket to the transmission bell housing and two brackets to pinion nose adaptor bolts. Separate the engine from the insulator by removing the upper nut washer assembly and through-bolt from the engine support bracket.
    b. On the right side, remove the two brackets to axle. Disconnect the housing bolts and one bracket-to-bell housing bolt. Separate the engine from the insulator by removing the upper nut/washer assembly and the through-bolt from the engine support bracket.
11. Disconnect and plug the rubber fuel inlet and return hoses from the fuel lines at the front of the vehicle. Lower, the vehicle.
12. Remove the air cleaner assembly and disconnect all linkages and cables. On the 3.9L engine, remove the throttle body. Stuff a clean shop towel into the intake manifold opening to prevent foreign objects from entering.
13. Unbolt the air conditioning compressor from the engine and position it to the side without discharging the system or disconnecting the lines.
14. Remove the radiator and shroud. Remove the fan and all related parts.
15. Unbolt the power steering pump brackets from the engine and position it to the side.
16. Remove the alternator, air pump and all brackets. Disconnect the heater hoses.
17. Remove the distributor cap with all spark plug wires attached. Discon-

nect all remaining electrical connectors, vacuum hoses and check for any other items preventing engine removal.

18. Attach a hoist or similar engine removal device to the intake manifold or cylinder head.

19. If the vehicle is equipped with an automatic transmission, support the transmission with a floor jack, or equivalent. Remove the remaining bell housing bolts.

20. Remove the engine from the vehicle slowly and carefully.

21. Lower the engine into position and install the engine mount bolts on the 2.5L engine. Install the upper bell housing bolts. Remove the hoist or engine removal device.

22. The remainder of installation is the reverse of removal. Tighten each component to specifications.

23. Fill the engine with the specified amount of oil and fill the radiator with coolant.

24. Connect the negative battery cable and set all adjustments to specifications.

DIESEL ENGINE

✱✱ CAUTION

This engine has a dry weight of 880 lbs. (400 kg). Make sure the engine removal equipment is rated adequately, or personal injury may result.

1. Scribe hood hinge outlines on the hood and remove the hood from the vehicle.
2. Disconnect the negative cable from the battery and from the engine.
3. Drain the coolant.

✱✱ CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

4. Remove the radiator, shroud, belt, fan and all related parts.
5. Remove the intake and exhaust pipes from the turbocharger.
6. Disconnect the air conditioner connections. Cover the openings on the compressor.
7. Disconnect the alternator and all other electrical connection to the engine.
8. Disconnect the accelerator linkage.
9. Disconnect the throttle linkage from the control lever, but do not remove the control lever from the injection pump.
10. Disconnect all engine driven accessories.
11. Raise the vehicle and support safely. Remove the starter.
12. If equipped with automatic transmission, remove the torque converter bolts and remove the lower bell housing bolts. If equipped with manual transmission, remove the transmission.
13. Drain the oil from the engine.

✱✱ CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

14. Disconnect the transmission oil cooler lines from their brackets, if equipped.
15. Disconnect the exhaust pipe from the turbocharger. Lower the vehicle.
16. Disconnect and plug the fuel lines.
17. Using the proper equipment, hoist the engine slightly using the lifting eyes and support the transmission, if still installed.
18. Remove the motor mounts and upper bell housing bolts.
19. Remove the engine from the vehicle.
20. Position the engine in the engine compartment and install the motor mounts. Tighten the nuts and bolts to 57 ft. lbs. (77 NS). The remainder of installation is the reverse of removal. Tighten each component to securely.
21. Fill the engine with the proper amount of diesel engine oil.
22. Fill the radiator with coolant. Connect the negative battery cable, set all adjustments to specifications and check for leaks.

Cylinder Head Cover

➡This cover may be referred to by various names. While official Mopar terminology has dubbed it Cylinder Head Cover, it may also be known as Rocker Arm Cover, Valve Cover, or (on OHC engines) Cam Cover. For the purposes of this manual, it will be called Cylinder Head Cover.

REMOVAL & INSTALLATION

▶ See Figures 7, 8, 9 and 10

1. Disconnect all wires, cable and hoses crossing the cylinder head cover. On the diesel engine, remove the air crossover tube.

✱✱ WARNING

The V10 engine uses specially plated fasteners. Do not replace these with another type.

2. On V10 engines, remove the upper intake manifold to remove the right side cylinder head cover.
3. Remove the cylinder head cover bolts.
4. Using a soft mallet, tap loose the cylinder head cover.

✱✱ WARNING

Never pry the cover loose. You may damage the cover or head surface!

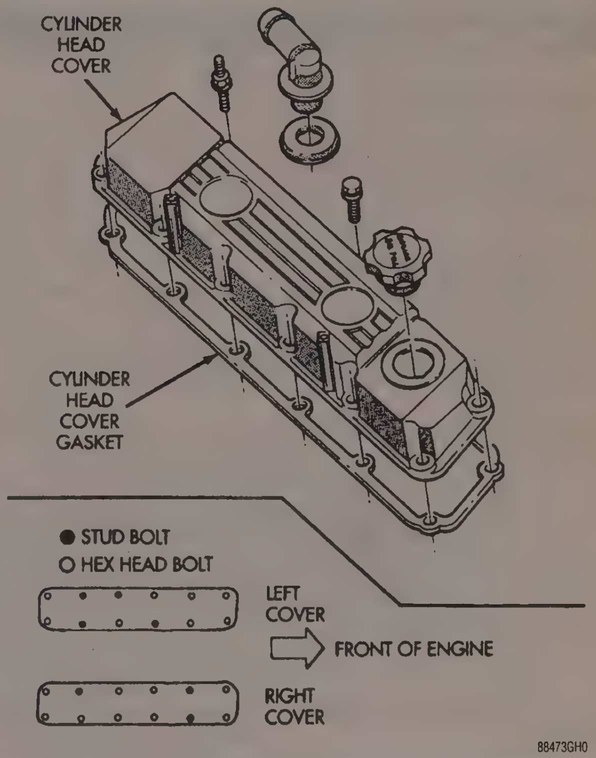


Fig. 7 Upper: Remove whatever is in the way of cylinder head removal (V10 cover shown, others similar). Lower: V10 engine bolt/stud arrangement

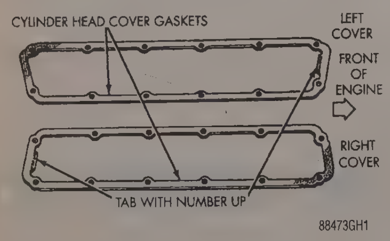


Fig. 8 The steel-backed silicone cylinder head cover head gaskets are reusable—V10 gasket shown, V6 and V8 models are similar

Fig. 9 Unbolt the cylinder head cover using a ratchet and extension

Fig. 10 Remove the cover from the cylinder head and set it in a clean, safe location

5. Lift the cover off the engine.
6. Thoroughly clean all gasket material from the mating surfaces of the head and cover. On models which use RTV silicone sealant instead of a gasket, make sure that all material is removed.

To install:

7. On models using a conventional gasket, place a new gasket on the head, coated with sealer. Coat the cylinder head cover mating surface with sealer and install the cover.
8. On later models using a steel-backed silicon gasket, install the original gasket unless it has somehow been damaged.
9. Tighten the bolts to the following:
   - V6 and V8 models with a conventional gasket: 4 ft. lbs. (4.5 Nm).
   - 2.5L engine: 105 inch lbs. (12 Nm).
   - On models with RTV silicone material, tighten the nuts to 80 inch lbs. (9 Nm); the studs to 10 ft. lbs. (13 Nm).
   - V10 engine: 144 inch lbs. (16 Nm).
   - V6 and V8 engines with steel-backed silicon gasket: 95 inch lbs. (11 Nm).
   - Diesel engine: tighten the cylinder head cover bolts and air crossover tube bolts to 18 ft. lbs. (24 Nm).

Rocker Arms/Shafts

REMOVAL & INSTALLATION

2.5L Engine

➧ See Figure 11

1. Disconnect the negative battery cable.
2. Remove the cylinder head cover.
3. Rotate the crankshaft until the low point of the desired cam lobe is contacting the rocker arm.
4. Use the special valve spring compressor tool, or equivalent, depress the valve spring (without dislodging the keeper) and slide the rocker arm out.

To install:

5. Depress the valve spring with the compressor tool and install in reverse order, turning the camshaft as necessary.
6. Install the cylinder head cover and connect the negative battery cable.

3.9L Engine

➧ See Figures 12, 13, 14 and 15

1. Disconnect the negative battery cable.
2. Remove the cylinder head cover and gasket.
3. Note the positioning of the oil notch and remove the rocker arms and shaft assembly from the head.
4. Disassemble the unit as required and replace all worn parts.

➡On engines with exhaust valve rotators, the exhaust rocker arm must have relief for clearance.

To install:

5. Make sure all rocker arms with an RH stamped on them are installed to the right of those with an LH. Install the assembly with the notch on the end of the shaft pointing to the engine centerline and to the rear of the right bank or to the front of the left bank. Make sure the longer stamped steel retainers are at the number 2 and 4 positions. Tighten the bolts evenly and gradually to 17 ft. lbs. (23 Nm).
6. Install the cylinder head cover and check for leaks.

V8 and V10 Engines

➧ See Figures 16, 17 and 18

The stamped steel rocker arms are arranged on one rocker arm shaft per cylinder head. Because the angle of the pushrods tend to force the rocker arm pairs toward each other, oilite spacers are fitted to absorb the side thrust at each rocker arm. The shaft is secured by bolts and steel retainers attached to the brackets on the cylinder head.

1. Disconnect the spark plug wires.
2. Disconnect the closed ventilation system and evaporative control system (if so equipped) from the cylinder head cover.

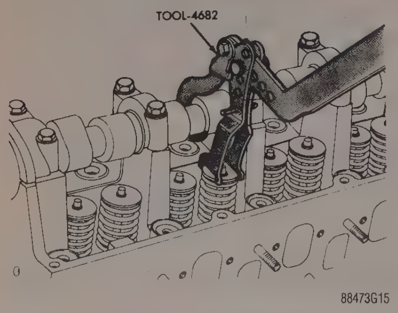


Fig. 11 Use a valve spring compressor tool to depress the valves—2.5L engine shown

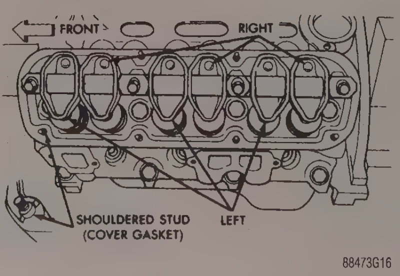


Fig. 12 Rocker arm location—left bank of the 3.9L engine

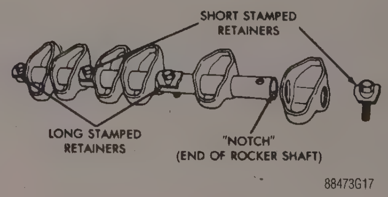


Fig. 13 Details of the rocker arm assembly—3.9L engine

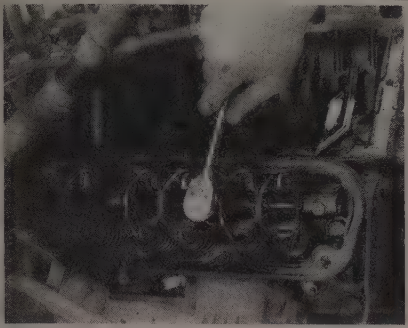


Fig. 14 Use a ratchet and the correct socket to unbolt the rocker arm assembly

Fig. 15 Lift the rocker arm assembly from the engine and put it in a clean, safe location

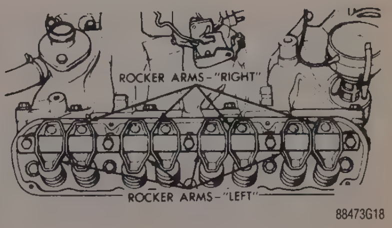

ROCKER ARMS–"RIGHT"
ROCKER ARMS–"LEFT"
88473G18

Fig. 16 Details of the rocker arm assembly as installed in the V8 engines

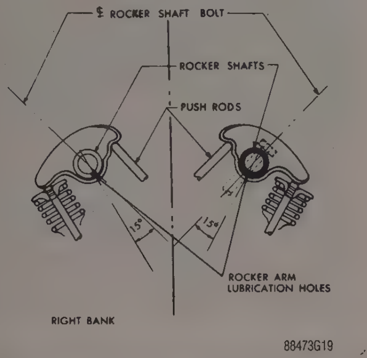

℄ ROCKER SHAFT BOLT
ROCKER SHAFTS
PUSH RODS
5°
15°
ROCKER ARM LUBRICATION HOLES
RIGHT BANK
88473G19

Fig. 17 Rocker arm design including location of the lubrication holes—V8 engines

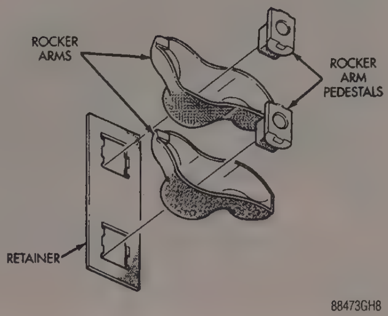

ROCKER ARMS
ROCKER ARM PEDESTALS
RETAINER
88473GH8

Fig. 18 Exploded view of the rocker arm assembly—V10 engine

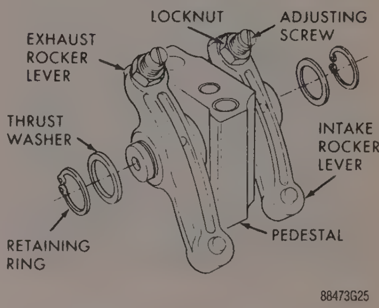

LOCKNUT
ADJUSTING SCREW
EXHAUST ROCKER LEVER
THRUST WASHER
INTAKE ROCKER LEVER
PEDESTAL
RETAINING RING
88473G25

Fig. 19 Details of the rocker arm components—diesel engine

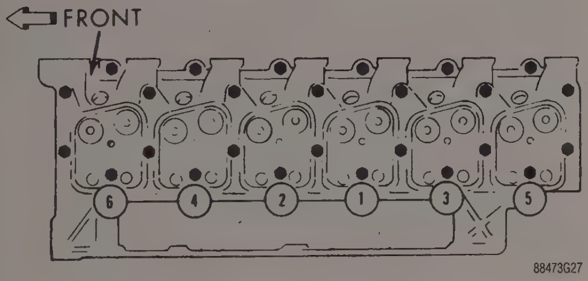

FRONT
6
4
2
1
3
5
88473G27

Fig. 20 Rocker arm bolt tightening sequence—diesel engine

3. Remove each cylinder head cover and gasket.
4. Remove the rocker shaft bolts and retainer.
5. Remove each rocker arm and shaft assembly. Keep everything in order for installation in the original position.

To install:

6. Install the components in the same order as removed. For V8 engines, the notch on the end of both rocker shafts should point to the engine centerline and toward the front of the engine on the left cylinder head and toward the rear on the right side.
7. For 1989–92 V8 models: tighten the rocker arm bolts to 17 ft. lbs. (23 Nm).
8. For all 1993–96 models: tighten the rocker arm bolts to 21 ft. lbs. (28 Nm).
9. Install the cylinder head and cover gasket.
10. Connect the spark plug wires.

Diesel Engine

➧ See Figures 19 and 20

1. Disconnect the negative battery cable.
2. Remove the cylinder head cover.
3. Loosen the adjusting screw locknuts. Loosen the screws until they stop.
4. Remove the 8mm bolt and 12mm bead bolt from the pedestal.
5. Remove the pedestal and rocker arm assembly. Remove the pushrods if necessary.
6. Remove the retaining ring and thrust washer.
7. Remove the rocker arm from the pedestal.

➡Do not disassemble the rocker shaft and pedestal; they must be replaced as an assembly.

8. Remove the locknut and adjusting screw from the rocker arm.
9. Installation is the reverse of removal. Please note the following important information.
    a. Lubricate the shaft with oil and install the rocker arm to the shaft.
    b. Install the pedestal and rocker arm assembly to the head aligning the dowel in the pedestal with the dowel bore in the head. If the pushrod is holding the pedestal off of the head, turn the engine until the pedestal will set on the head without interference.
    c. Lubricate the threads of the bolt with oil. Install and torque first to 29 ft. lbs. (40 Nm), then to 62 ft. lbs. (85 Nm) and finally to 93 ft. lbs. (126 Nm). If all of the pedestals were removed, follow the entire head bolt torque sequence including those head bolts that were not removed in this procedure. Tighten the 8mm bolts of 18 ft. lbs. (24 Nm).
    d. Adjust the valves.
    e. Install the cylinder head cover with a new gasket. Tighten the bolts to 18 ft. lbs. (24 Nm).

Thermostat

REMOVAL & INSTALLATION

Gasoline Engines

◗ See Figures 21, 22, 23 and 24

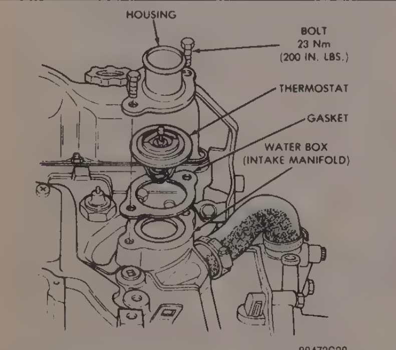
➡The thermostat on all gasoline-powered vehicles is located beneath the thermostat housing at the front of the intake manifold.

1. Drain the cooling system to below the level of the thermostat.

✻✻✻ CAUTION

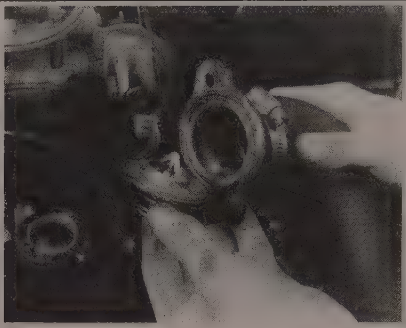
When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

2. For 1994–96 V6 and V8 models equipped with air conditioning:
   a. Remove the support bracket (rod) located near the rear of the alternator.
   b. Remove the drive belt.



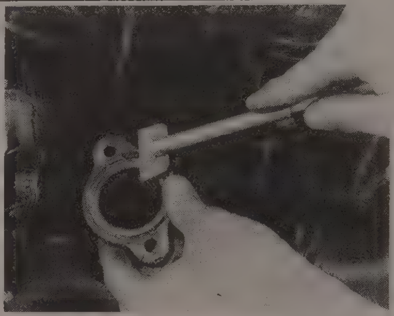
88473G28

Fig. 21 Exploded view of the thermostat installation—V6 and V8 engines



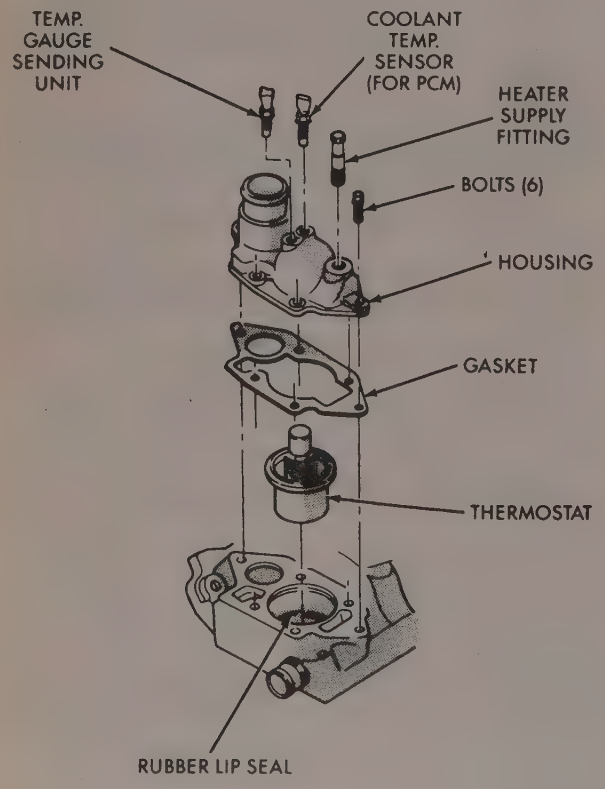
88473P00

Fig. 22 Remove the thermostat from its housing



88473P01

Fig. 23 Clean away all remaining gasket material and old sealer, if any, to ensure a tight fit upon installation



88473G11

Fig. 24 Exploded view of the thermostat assembly—V10 engine

   c. Partially remove the alternator by removing the necessary alternator bolts. If equipped with 4WD, unplug the 4WD indicator lamp harness (at the rear of the unit).
   d. Remove the alternator. Position it to gain access for thermostat gasket removal.
3. On V10 engines, remove the two support rod mounting bolts and remove the support rod (intake manifold-to-alternator mount).
4. All models: Remove the upper radiator hose from the thermostat housing. Note the positioning of the thermostat. It is important that the thermostat is correctly installed.
5. Withdraw the housing bolts and remove the housing and the thermostat.

To install:

6. To install, use a new gasket and position the thermostat so that its pellet end (the part with the spring) is toward the engine block. On the 3.9L engine, the vent hole must be up. Refit the thermostat housing and tighten its securing bolts to 25–30 ft. lbs. (34–41 Nm).
7. Connect the upper radiator hose.
8. The remainder of installation is the reverse of removal. Tighten each component securely.

Diesel Engine

◗ See Figure 25

1. Disconnect the negative battery cable.
2. Drain the coolant.

✻✻✻ CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

3. Use a ⅜ in. drive breaker bar to lift the belt tensioner and remove the belt.

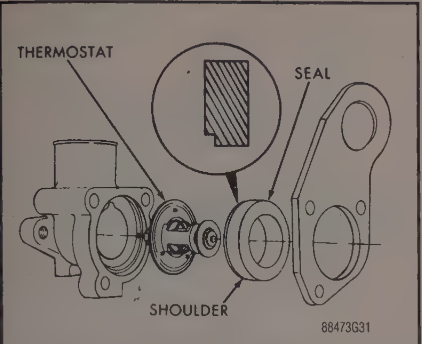

THERMOSTAT
SEAL
SHOULDER
88473G31

Fig. 25 Be careful to install the diesel engine thermostat seal as shown

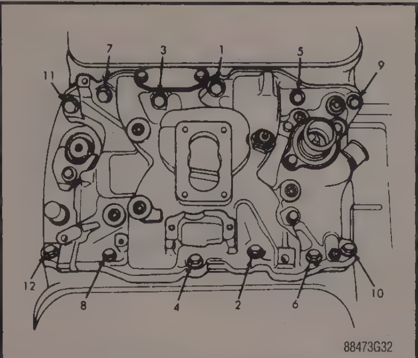

7
3
1
5
9
11
12
8
4
2
6
10
88473G32

Fig. 26 Torque sequence for the V6 engine intake manifold

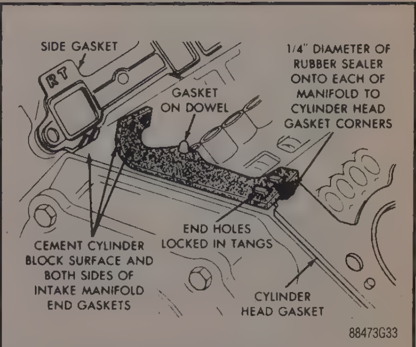

SIDE GASKET
RT
GASKET ON DOWEL
1/4" DIAMETER OF RUBBER SEALER ONTO EACH OF MANIFOLD TO CYLINDER HEAD GASKET CORNERS
END HOLES LOCKED IN TANGS
CEMENT CYLINDER BLOCK SURFACE AND BOTH SIDES OF INTAKE MANIFOLD END GASKETS
CYLINDER HEAD GASKET
88473G33

Fig. 27 Seal the intake manifold as shown—V6 engines

Fig. 28 Remove the throttle cable from the throttle body

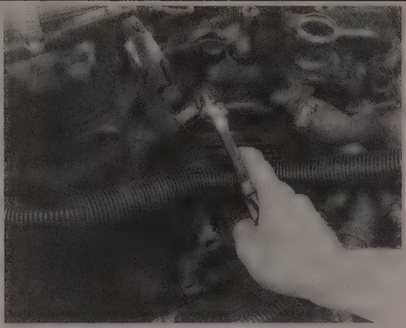


Fig. 29 Unbolt the intake manifold from the engine

Fig. 30 When unbolted, remove the intake manifold (complete with throttle body) from the engine

Fig. 31 An engine with its intake manifold removed—clean the mating surfaces before reinstalling

4. Disconnect the upper radiator hose from the thermostat housing.
5. Loosen the alternator mounting bolts and lower the alternator.
6. Unbolt the thermostat housing and remove the housing engine lifting bracket and thermostat with seal.
7. Installation is the reverse of removal. Pay particular attention to the following information:
    a. Install the new thermostat to the housing, making sure the tang on the thermostat is aligned with the slot in the housing. This will ensure correct positioning of the jiggle pins in the housing. This is important because during filling, air vents through the jiggle pin openings through the upper hose and out the radiator fill neck.
    b. Make sure the seal is installed with the beveled side facing out.
    c. Tighten the thermostat housing bolts to 18 ft. lbs. (24 Nm).
    d. Run the vehicle until the thermostat opens, fill the radiator completely and check for leaks. Once the vehicle has cooled, recheck the coolant level. With the Thermostat plug on the relief valve removed from the thermostat housing, fill the radiator with coolant until the coolant comes out the plug hole. Install the plug or valve and continue to fill the radiator.

Intake Manifold

REMOVAL & INSTALLATION

2.5L Engine

Please refer to the combination manifold procedure for the 2.5L engine.

3.9L Engine

➧ See Figures 26, 27, 28, 29, 30 and 31

1. Relieve the fuel pressure. Disconnect the negative battery cable from the battery and drain the cooling system.

✲✲ CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

2. Remove the air pump and bracket. Removal of the bracket will allow for easier installation of the left front corner of the intake manifold.
3. Remove the air cleaner assembly. Unbolt the air conditioning compres-

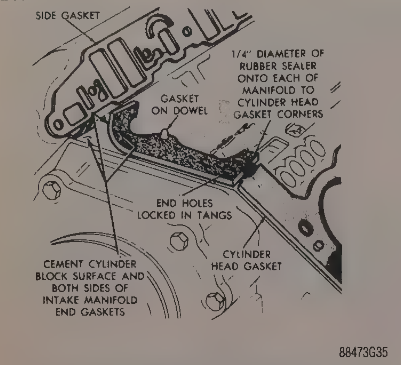

SIDE GASKET
1/4" DIAMETER OF RUBBER SEALER ONTO EACH OF MANIFOLD TO CYLINDER HEAD GASKET CORNERS
GASKET ON DOWEL
END HOLES LOCKED IN TANGS
CEMENT CYLINDER BLOCK SURFACE AND BOTH SIDES OF INTAKE MANIFOLD END GASKETS
CYLINDER HEAD GASKET
88473G35

Fig. 32 Seal the intake manifold as shown—V8 engines

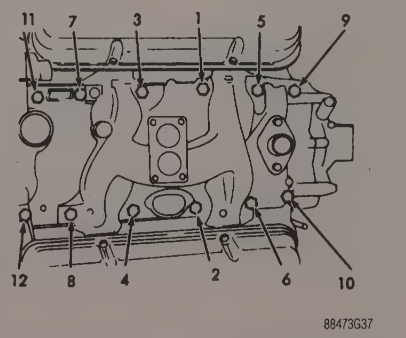


Fig. 33 V8 engine intake manifold tightening sequence

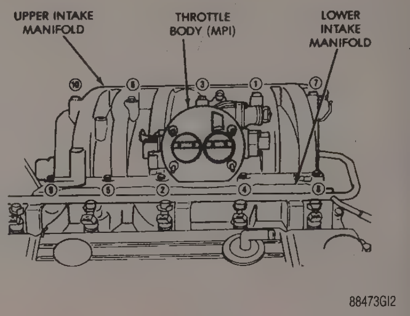


Fig. 34 Details of the upper intake manifold and throttle body assembly—V10 engine

sor and lay it to the side, if equipped. Remove the distributor cap with all wires attached.

4. Disconnect all wires, hoses, linkages and cables from the throttle body. Disconnect the fuel line.
5. Disconnect the ignition coil, coolant temperature sending unit wire and all other connectors along the wiring harness connected to items on the intake manifold.
6. Disconnect the heater hose, upper radiator hose and the lower bypass hose clamp.
7. Remove the cylinder head covers.
8. Unbolt the intake manifold from the heads and remove the intake manifold assembly. Disassemble the manifold as required and clean out the exhaust crossover passages.
9. Installation is the reverse of removal. Pay particular attention to the following information.
   a. Clean and dry the intake manifold contact surfaces. Coat the intake manifold side gaskets very lightly with sealer and install the gaskets to the heads. Cutouts at the front of the gaskets differentiate the right and left sides. Apply a thin uniform coat of quick dry cement to the front and rear intake manifold gaskets and mounting surfaces on the block and apply a thin bead of sealer to each of the four corners. Install the front and rear gaskets engaging the hole in the block and the tangs from the head gaskets. Apply a second thin bead of sealer above the gaskets in the four corners.
10. Install the intake manifold bolts with the aspirator tube, air pump bracket and kickdown linkage bracket in place, if equipped. Tighten the bolts in sequence to 72 in. lbs. (34 Nm). Repeat the sequence retightening the bolts to a final torque of 12 ft. lbs. (54 Nm) and repeat the second step to ensure all bolts are accurately torqued.
11. Fill the cooling system.
12. Connect the negative battery cable. Turn the ignition **ON** to repressurize the fuel system by activating the fuel pump. Check for leaks.

5.2L and 5.9L Engines

➧ See Figures 32 and 33

1. Drain the cooling system and disconnect the negative battery cable.

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

2. Remove alternator and air cleaner.
3. Disconnect accelerator linkage.
4. Depressurize the fuel system and disconnect the fuel line.
5. Remove the distributor cap and wires.
6. Disconnect coil wires, temperature sending unit wire, heater hoses and bypass hose.
7. Remove intake manifold and throttle body as an assembly.

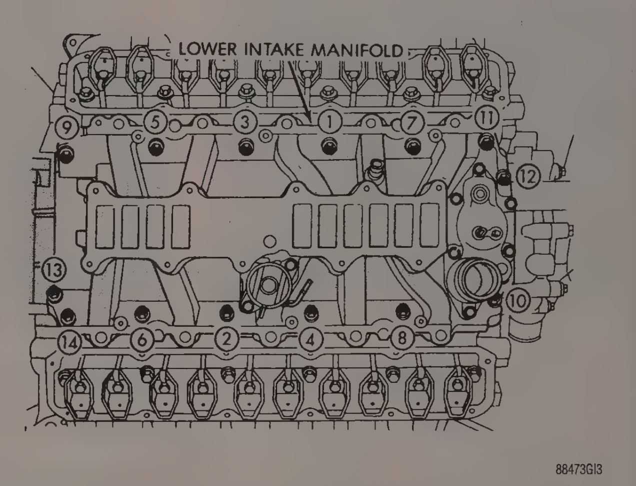


Fig. 35 Details of the lower intake manifold—V10 engine

8. Installation is the reverse of removal. Tighten the intake manifold to head bolts in the sequence illustrated.

8.0L Engines

➧ See Figures 34, 35, 36 and 37

1. Drain the cooling system and disconnect the negative battery cable.
2. Remove alternator and air cleaner.
3. Remove the serpentine belt.
4. Remove the alternator and its brace.
5. Remove the air conditioning compressor brace, remove the compressor and set it aside without disconnecting the lines.
6. Remove the air cleaner cover and filter. Remove the filter. Discard the gasket.
7. Depressurize the fuel system and disconnect the fuel line.
8. Disconnect accelerator linkage, and if so equipped, the speed control and transmission kickdown cables.
9. Remove the coil assemblies. Disconnect the vacuum lines.
10. Disconnect the heater hoses and bypass hose.
11. Remove the closed crankcase ventilation and evaporation control systems.
12. Remove throttle body and lift it off the upper intake manifold. Discard the gasket.
13. Remove the front upper intake manifold bolts. Retain the three rear bolts in the up position with tape or rubber bands.
14. Lift the upper intake manifold out of the engine bay. Discard the gasket.
15. Remove the lower intake manifold bolts and remove the manifold. Discard the gasket.

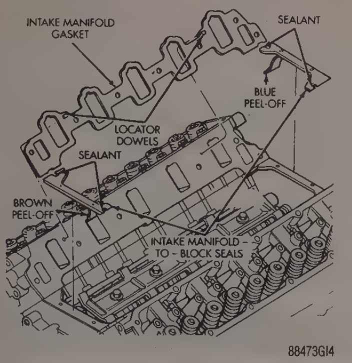

INTAKE MANIFOLD GASKET
SEALANT
BLUE PEEL-OFF
LOCATOR DOWELS
SEALANT
BROWN PEEL-OFF
INTAKE MANIFOLD - TO - BLOCK SEALS
88473G14

Fig. 36 Exploded view of the lower intake manifold gaskets—V10 engine

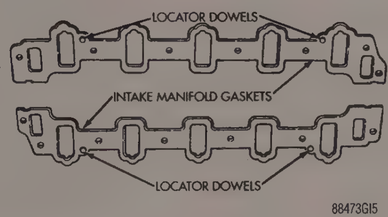

LOCATOR DOWELS
INTAKE MANIFOLD GASKETS
LOCATOR DOWELS
88473G15

Fig. 37 Align the intake manifold flange gasket—V10 engine

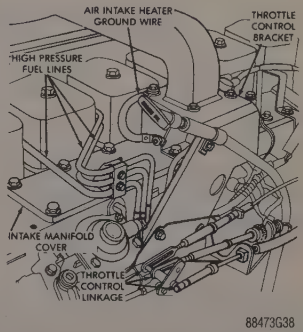

AIR INTAKE HEATER GROUND WIRE
THROTTLE CONTROL BRACKET
HIGH PRESSURE FUEL LINES
INTAKE MANIFOLD COVER
THROTTLE CONTROL LINKAGE
88473G38

Fig. 38 Remove the components that block the removal of the intake manifold—diesel engines

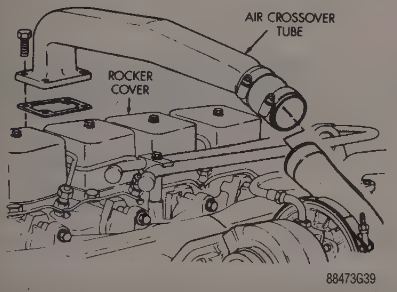

AIR CROSSOVER TUBE
ROCKER COVER
88473G39

Fig. 39 Remove the air crossover tube for access to the intake manifold—diesel engine

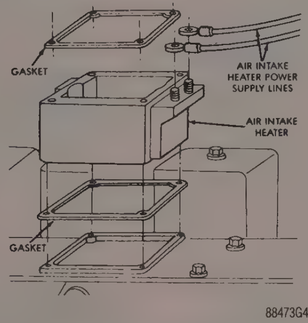

GASKET
AIR INTAKE HEATER POWER SUPPLY LINES
AIR INTAKE HEATER
GASKET
88473G40

Fig. 40 Exploded view of the intake air heater that must be removed to access the intake manifold

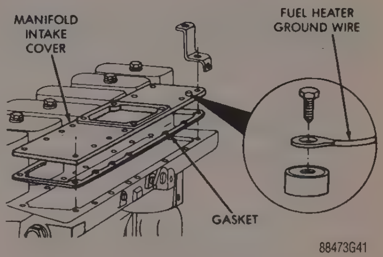

MANIFOLD INTAKE COVER
FUEL HEATER GROUND WIRE
GASKET
88473G41

Fig. 41 Remove the intake manifold cover on the diesel engine—note the location of the fuel heater ground wire

16. Installation is the reverse of removal. Clean the manifolds and mounting surfaces with solvent and let dry or dry completely with compressed air.
17. When sure that the block is oil-FREE, peel off the paper (blue-rear, brown-front) and press firmly onto the block. Align the slots in the end seals with the notches in the intake manifold gaskets.
18. Into each of the four corner pockets, insert Mopar®Silicon Rubber Adhesive Sealant, or equivalent. Do NOT overfill. The lower intake manifold must be installed within three minutes of the sealant's having been applied. After in place, inspect to be sure all the gaskets and the seals are in their proper places. Finger-start all lower intake bolts. Tighten in sequence to 40 ft. lbs. (54 Nm).
19. Install a new gasket and the upper intake manifold and finger-tighten all bolts. Alternate from one side to the other. Tighten the bolts to 16 ft. lbs. (22 Nm).
20. Install a new gasket and the throttle body onto the upper intake manifold. Tighten the bolts to 17 ft. lbs. (23 Nm). Fill the cooling system and connect the negative battery cable.

Diesel Engine

➧ See Figures 38, 39, 40 and 41

1. Disconnect the negative battery cable.
2. Remove the throttle control bracket and linkage.
3. Remove the high pressure fuel lines.
4. Disconnect the intake manifold heater.
5. Disconnect the fuel heater ground wire from the intake manifold.
6. Remove the air crossover tube and the intake manifold heater.
7. Remove the manifold cover and gasket. Clean the gasket sealing surface.
8. Installation is the reverse of removal. Install the new gasket and cover. Some of the bolt holes are drilled through. Apply liquid Teflon®sealant to these bolts. Torque all bolts to 18 ft. lbs. (24 Nm).
9. Install and bleed the high pressure fuel lines.

Exhaust Manifold

REMOVAL & INSTALLATION

2.5L Engine

Please refer to the combination manifold procedure for the 2.5L engine.

3.9L Engine

➧ See Figure 42

1. Disconnect the negative battery cable.
2. Remove the hot air tube and heat shield, if necessary.

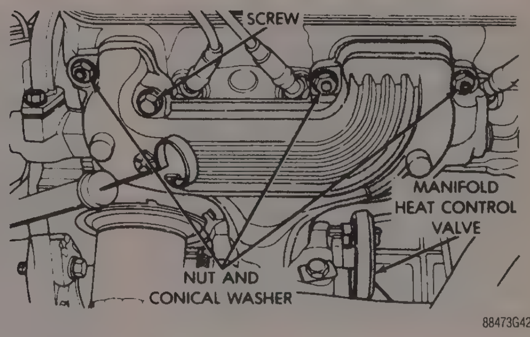

SCREW
MANIFOLD HEAT CONTROL VALVE
NUT AND CONICAL WASHER
88473G42

Fig. 42 Remove the hardware shown to detach the exhaust manifold—V6 engine

3. Raise the vehicle and safely support it on jackstands.
4. Remove the exhaust pipe from the exhaust manifolds.
5. Lower the vehicle.
6. Take note of all conical washer locations and remove the bolts, nuts and washers attaching the manifold to the head.
7. Remove the manifold.
8. Installation is the reverse of removal. Secure the bolts and washers in their proper locations. The inner bolts are not mounted with washers. Working outward from the center, tighten the bolts to 20 ft. lbs. (27 Nm) and the nuts to 15 ft. lbs. (20 Nm).

5.2L and 5.9L Engines

➧ See Figure 43

1. Disconnect the exhaust manifold at the flange where it mates to the exhaust pipe.
2. If the vehicle is equipped with air injection and/or a heated air stove, remove them.
3. Remove the exhaust manifold by removing the securing bolts and washers. To reach these bolts, it may be necessary to jack the engine slightly off its front mounts. When the exhaust manifold is removed, sometimes the securing studs will screw out with the nuts. If this occurs, the studs must be replaced with the aid of sealing compound on the coarse thread ends. If this is not done, water leaks may develop at the studs.
4. Installation is the reverse of removal. Tighten all components securely.

8.0L Engine

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Remove the hardware that attaches the exhaust pipe to the exhaust manifold.
4. Lower the vehicle.
5. Remove the exhaust heat shields.
6. To remove the right exhaust manifold:
   a. Remove the EGR tube. Discard the gasket.
   b. Remove the dipstick bracket from the manifold.
7. Unbolt and remove the exhaust manifold. Discard the gasket.

To install:

8. Clean the surfaces so they are free of old material, oil, grease, etc, Inspect the surfaces for cracks and check flatness with a straightedge and feeler gauge. The mounting surfaces must be flat within 0.008 in./ft. (0.2mm/300mm).
9. Install a new gasket and the exhaust manifold(s). Once installed in the correct order, tighten the stud bolts and bolts to 16 ft. lbs. (22 Nm).
10. For the right side manifold:
   a. Install a new gasket and the EGR tube. Tighten the tube assembly nut to 25 ft. lbs. (34 Nm). Tighten the two EGR nuts to 175 inch lbs. (20 Nm).
   b. Install the dipstick bracket to the manifold.
11. The remainder of installation is the reverse of removal.

Diesel Engine

➧ See Figures 44 and 45

1. Disconnect the negative battery cable.
2. Disconnect the air intake hose and exhaust pipe from the turbo.
3. Remove the turbocharger and gasket.
4. Remove the cab heater supply and return lines.
5. Remove the exhaust manifold and gasket. Clean the gasket sealing surface.
6. Installation is the reverse of removal. Secure the exhaust manifold bolts in sequence to 32 ft. lbs. (43 Nm).

Combination Manifold

REMOVAL & INSTALLATION

➧ See Figure 46

This procedure applies only to the 2.5L engine. The "combination manifold" is, in fact, the intake and exhaust manifold intermeshed into one unit.

➡On some vehicles, some of the manifold attaching bolts may not be accessible or are too heavily sealed from the factory. Examine the mounting hardware prior to committing yourself to this procedure. If you find this to be the case, it will be necessary to remove the cylinder head, then separate the manifold from the cylinder head on a workbench.

1. Disconnect the negative battery cable.
2. Drain the cooling system.

✲✲ CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

3. Depressurize the fuel system. Remove the air cleaner and disconnect all vacuum lines, electrical wiring and fuel lines from the throttle body and/or manifold.
4. Disconnect the throttle linkage.
5. Loosen the power steering pump and remove the drive belt. Remove the power steering and air pump support bracket.
6. Remove the power brake vacuum hose from the intake manifold.
7. On Canadian models, remove the coupling hose from the diverter valve to the exhaust manifold air injection tube assembly.
8. Remove the water hoses from the water crossover.
9. Raise and safely support the vehicle. Disconnect the exhaust pipe from the exhaust manifold.
10. Remove the power steering pump and set it aside.

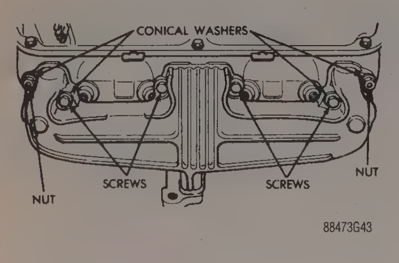


Fig. 43 Remove the hardware shown to detach the exhaust manifold—V6 engine

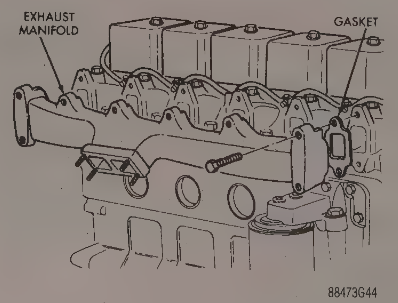


Fig. 44 Fit the gaskets as shown for the exhaust manifold—diesel engine

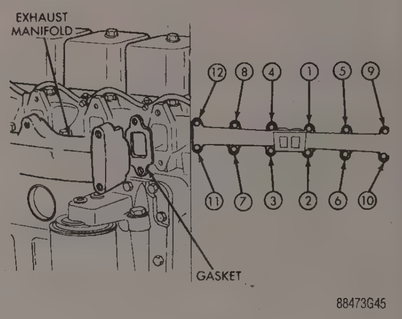


Fig. 45 Tightening sequence for the diesel engine exhaust manifold

11. Remove the intake manifold support bracket, if equipped.
12. Remove the EGR tube.
13. If equipped, remove the air injection tube bolts and the air injection tube assembly.
14. Remove the intake manifold bolts.
15. Lower the vehicle and remove the intake manifold.
16. Remove the exhaust manifold nuts and extract the unit.

To install:

17. Install a new combination manifold gasket lightly coated on the manifold side with Mopar®Gasket Sealer, or equivalent.
18. Set the gasket in place and install and tighten the nuts to 17 ft. lbs. (23 Nm). The tightening should begin in the center and progress outwards in both directions.
19. Repeat the tightening sequence until all nuts are at the specified torque.
20. Install the intake manifold strut and tighten the bolt to 70 ft. lbs. (95 Nm) and nut to 40 ft. lbs (54 Nm). The remainder of installation is the reverse of removal. Tighten each component to specifications.
21. Install the exhaust pipe to the exhaust manifold, tightening to 20 ft. lbs. (27 Nm).
22. Fill the cooling system, start the engine and check for leaks.

Turbocharger

REMOVAL & INSTALLATION

▶ See Figure 47

➡This procedure pertains to the diesel engine only.

1. Disconnect the negative battery cable.
2. Loosen the air crossover hose.
3. Disconnect the intake hose and exhaust pipe.
4. Remove the oil drain tube bolts.
5. Remove the oil supply line from the turbocharger.
6. Remove the turbocharger mounting nuts and remove the turbocharger.
7. Installation is the reverse of removal. Pay attention to the following:

- Turbocharger mounting nuts—24 ft. lbs. (32 Nm).
- Install a new gasket and tighten the oil drain tube bolts to 18 ft. lbs. (24 Nm).
- New turbochargers must be pre-lubricated with fresh engine oil before operation. To do so, pour about 2 or 3 oz. (65–100 ml) of oil into the supply fitting and rotate the turbine wheel to circulate the oil.

Radiator

REMOVAL & INSTALLATION

▶ See Figures 48 thru 56

1. Drain the cooling system.

✻✻ CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

2. Disconnect the negative battery cable.
3. Detach the upper hose from the radiator.
4. Remove the shroud mounting nuts and position it out of the way.
5. Remove the radiator top mounting screws. If equipped with air conditioning, remove the condenser attaching screws, accessible through the grille. Do not disconnect any air conditioning lines.

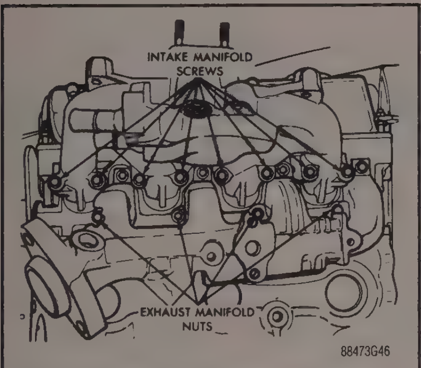


Fig. 46 Remove the fasteners to detach the combination manifold—2.5L engine

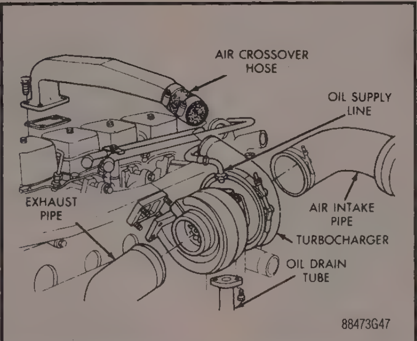


Fig. 47 Exploded view of the turbocharger mounting—diesel engine

Fig. 48 Remove the hose clamp and pull the upper hose from the radiator

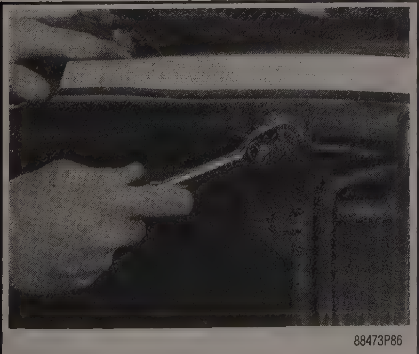


Fig. 49 Unscrew the top of the radiator from the radiator support

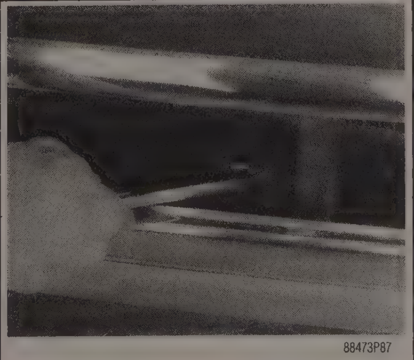


Fig. 50 Remove the air conditioning condenser attaching screws through the grille

Fig. 51 Unscrew and move (or remove) the radiator shroud to give clearance for the radiator removal

88473P89

Fig. 52 Unbolt the radiator once the shroud is out of the way

88473P90

Fig. 53 When completely detached, lift the radiator out of the vehicle—do not lay it flat on the finned surface

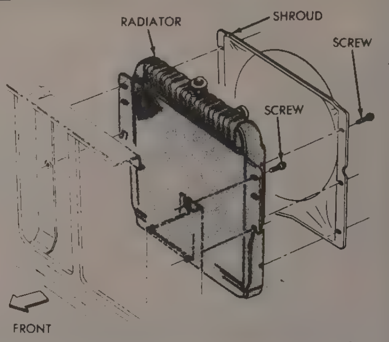

RADIATOR
SHROUD
SCREW
SCREW
FRONT
88473G48

Fig. 54 Exploded view of a typical radiator and fan shroud—Ram models

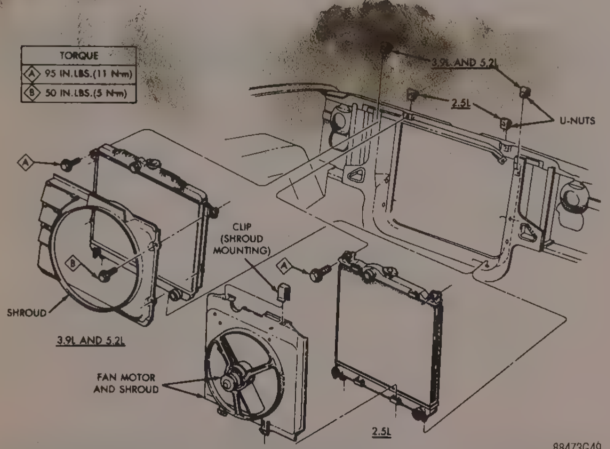

TORQUE
Ⓐ 95 IN.LBS.(11 N·m)
Ⓑ 50 IN.LBS.(5 N·m)
3.9L AND 5.2L
2.5L
U-NUTS
A
B
CLIP (SHROUD MOUNTING)
A
SHROUD
3.9L AND 5.2L
FAN MOTOR AND SHROUD
2.5L
88473G49

Fig. 55 Exploded view of the radiator and fan shroud—Dakota models

6. Raise the vehicle and support it.
7. Disconnect and plug the automatic transmission cooler lines and cap the openings in the cooler.
8. Hold the radiator in place and remove the lower mounting screws. Carefully lift it up and out of the truck.
9. Installation is the reverse of removal. Tighten each components securely.
10. Fill the cooling system. Check all fluid levels and run the engine, making sure there are no leaks.

Belt-Driven Engine Fan

REMOVAL & INSTALLATION

➧ See Figures 57, 58, 59 and 60

➡This procedure pertains to all models except the 2.5L Dakota. For the 2.5L Dakota, refer to the Electric Engine Fan procedure.

1. Remove the fan shroud from the radiator and position it out of the way.
2. Loosen the fan drive belt.
3. Remove the fan and fluid drive assembly from the water pump.
4. Remove the fan from the fluid drive (fan clutch) on a workbench.

To install:

➡A fluid fan drive should be replaced if there is any indication of a fluid leak at the shaft seal, if noise or roughness is felt when turning the unit by hand, if the unit is seized, or if the fan blade tip can be moved more than ¼ in.(6mm) from the front to rear.

5. Install the fan on the fan drive and the belt and fan shroud.

Electric Engine Fan

This fan is not serviceable. If it is found inoperative, it must be replaced with the recommended Original Equipment Manufactured (OEM) equivalent to ensure adequate strength, performance and safety.

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Unplug the wire connector.

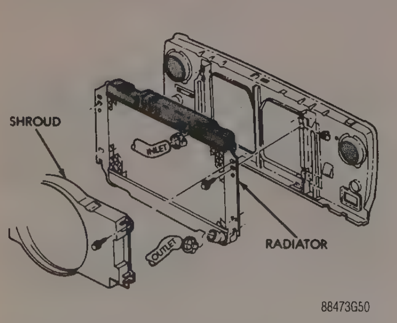

SHROUD
INLET
RADIATOR
OUTLET
88473G50

Fig. 56 Exploded view of the radiator and fan shroud—diesel models

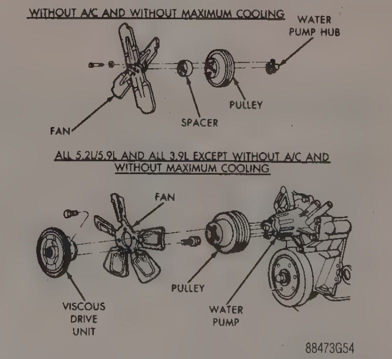

WITHOUT A/C AND WITHOUT MAXIMUM COOLING
WATER PUMP HUB
PULLEY
SPACER
FAN
ALL 5.2L/5.9L AND ALL 3.9L EXCEPT WITHOUT A/C AND WITHOUT MAXIMUM COOLING
FAN
PULLEY
VISCOUS DRIVE UNIT
WATER PUMP
88473G54

Fig. 57 Exploded view of the engine fan mounting—V6 and V8 engines

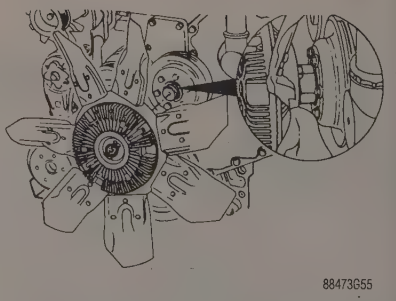

88473G55

Fig. 58 Details of the engine fan mounting—diesel engine

Fig. 59 Unbolt the fan assembly and remove it from its hub

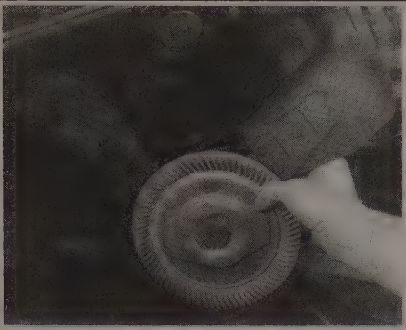


Fig. 60 Keep the fan assembly upright when you remove it

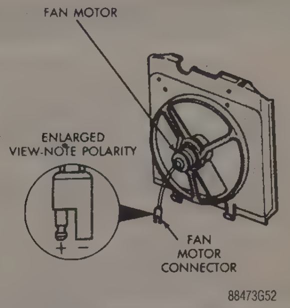


Fig. 61 When testing the fan motor, make sure to hook the correct polarity jumper wire to the harness connector—2.5L Dakota models only

3. Remove the fasteners and remove the fan, shroud and motor from the radiator as an assembly.
4. Support the fan motor and shaft on a bench. Remove the retaining clip to detach the fan blade.

✻✻ WARNING

Do not allow the fan blades to contact the bench.

5. Installation is the reverse of removal.

TESTING

Fan Motor

▸ See Figure 61

The cooling fan motor can be tested by applying 12 volts (battery voltage) to the fan motor electrical connector.

1. Unplug the fan motor connector.
2. Hook a 14 gauge positive jumper from the battery to the male prong of the connector (positive) and a 14 gauge negative probe to the female connector (negative)
3. If the fan operates normally, the motor is operating properly. Proceed to the circuit diagnosis test.
4. If the fan motor does not operate with voltage applied, it is faulty and should be replaced.

Circuit Diagnosis

▸ See Figure 62

➡If the fan relay does not have the circuit number embossed, you will have to acquire a schematic.

1. With the ignition switch **OFF**, check for battery voltage at terminal No. 1 of the fan relay connector.

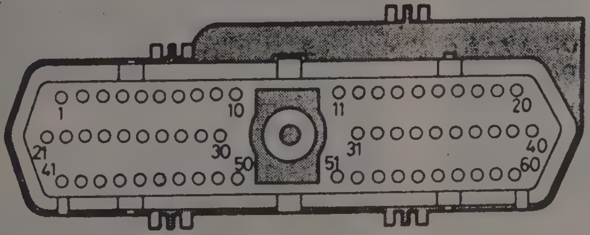


Fig. 62 Test the PCM terminals—inspect to see that none are bent and not making contact

2. If battery voltage is not present, check the cartridge fuse in the Power Distribution Center (PDC). Inspect for an open or short to ground in circuit C26.
3. If battery voltage is present, continue to the next step.
4. Connect a 14 gauge jumper wire between the fan relay connector terminals (B) and (D).
5. If the fan does not operate, check for an open in circuit C25. Check this between terminal (D) of the fan relay connector and fan motor connector.
6. Start the engine and allow it to reach normal operating temperature.
7. If the fan does operate, proceed to the next step.
8. Inspect the wire connectors in circuits C9, C25 and C26 for proper engagement. The circuit number appears in front of the wire gauge and color description of the wiring diagrams.
9. If you have available a DRB scan tool, check the on-board diagnostics for trouble codes (DTC).
10. If you do not have the factory scan tool, you can still check the Radiator Fan Relay Circuit on speculation, as this is the most likely DTC that would be displayed by the scan tool.
11. With the engine in the **RUN** position, test for battery voltage at the J2 circuit connection of the fan relay.
12. If the voltage reading is correct, proceed to Step 13a. If voltage is 0–1, proceed to Step 13b.
13. With the ignition **OFF**, disconnect the 60-way wiring harness plug from the PCM. Turn the ignition key to **RUN**. Test for battery voltage with a voltmeter at cavity 31.
    a. If battery voltage is present at cavity 31, and the female terminal is not damaged, replace the PCM.
    b. If voltage is 0, repair the open or short in circuit C27.
14. With the ignition **OFF**, unplug the 60-way connector from the PCM. Turn the ignition switch to **RUN**. Test for battery voltage at the J2 circuit connection of the fan relay.
    a. If battery voltage is present, replace the PCM.
    b. If the voltage reading is 0–1, proceed to Step 15.
15. With the ignition switched to the **RUN**position, test for battery voltage at circuit C27 connection of the fan relay.
    a. If battery voltage is present, replace the fan relay.
    b. If the voltage is 0, repair the open or short in circuit C27.

Water Pump

REMOVAL & INSTALLATION

2.5L Engine

▸ See Figures 63 and 64

1. Disconnect the negative battery cable.

➡When removing or installing the constant tension hose clamps from vehicles so equipped, use only the correct clamp tool, such as the Snap-On No. HPC-20, or equivalent.

2. Drain the cooling system.

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container.

3. If the vehicle is equipped with air conditioning, remove the compressor from the bracket and position it to the side.
4. Raise the vehicle and support safely, if necessary and remove the alternator and bracket. Remove the pulley from the water pump.
5. Disconnect the lower radiator hose and heater hose from the water pump.
6. Remove the water pump housing attaching screws and remove the assembly from the vehicle. Discard the O-ring.
7. Remove the water pump from the housing.

To install:

8. Clean the mating surfaces prior to sealing the water pump.

➡This component is subjected to constant high pressure from hot fluid and must be sealed correctly or it will leak.

9. Using a new gasket or silicone sealer, install the water pump to the housing.
10. Install a new O-ring to the housing and install to the engine. Tighten the bolts to 21 ft. lbs. (30 Nm).
11. The remainder of installation is the reverse of removal. Remove the hex-head plug on the top of the thermostat housing (some carbureted engines have a vacuum switching valve at that location). Fill the radiator with coolant until the coolant comes out the plug hole. Install the plug or valve and continue to fill the radiator.
12. Connect the negative battery cable, run the vehicle until the thermostat opens, fill the radiator completely and check for leaks. Once the vehicle has cooled, recheck the coolant level.

3.9L Engine

➧ See Figures 65, 66, 67 and 68

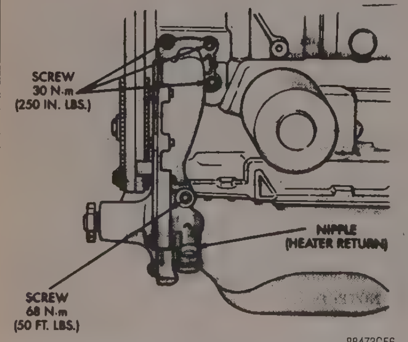
1. Disconnect the negative battery cable.
2. Drain the coolant.

➡When removing or installing the constant tension hose clamps from vehicles so equipped, use only the correct clamp tool, such as the Snap-On No. HPC–20, or equivalent.

3. Remove the radiator and lower hose.
4. Remove the fan blade, spacer or viscous drive unit, pulley, bolts and shroud together. Remove the air pump belt and power steering pump belt.

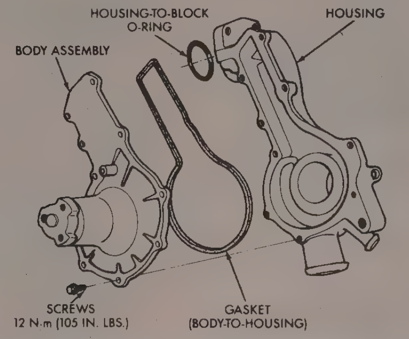
➡Do not place the viscous fan in an upright position because the silicone fluid in the drive could drain into the bearing and contaminate its lubricant.

5. Loosen the alternator mounting bolts and remove the alternator/air conditioning or idler pulley belt(s).
6. Remove the alternator bracket. This bracket also supports the air conditioning compressor or idler pulley, which will remain supported by its rear mount.
7. Remove the air pump. Remove the air pump bracket and unbolt the power steering pump bracket with the pump still attached and position it out of the way.
8. Disconnect the heater hose and bypass hose.
9. Remove the air conditioning compressor pulley and field coil assembly, if necessary to remove the water pump to compressor front mount bolts and bracket.
10. Remove the remaining pump retaining bolts (if any) and remove the pump from the engine.
11. Installation is the reverse of removal. Secure the water pump retaining bolts that do not go through adjusting slots to 30 ft. lbs. (41 Nm).
12. Connect the negative battery cable, run the vehicle until the thermostat opens, fill the radiator completely and check for leaks. Once the vehicle has cooled, recheck the coolant level.



88473G56

Fig. 63 Unbolt the water pump at the locations shown—2.5L engine



88473G57

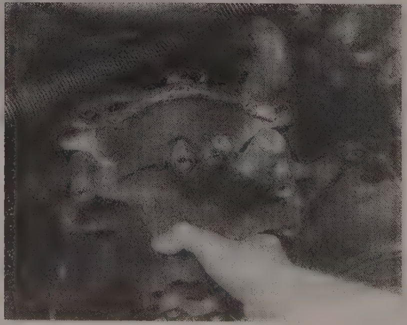
Fig. 64 Exploded view of the water pump assembly including the gasket

88473P12

Fig. 65 Remove the hoses from the water pump assembly

88473P13

Fig. 66 Once all the hoses are detached, unbolt the water pump from the engine



88473P14

Fig. 67 Separate the water pump and set it aside

88473P15

Fig. 68 Scrape away all old gasket material—take care not to gouge the surface

5.2L and 5.9L Engines

1. Remove the radiator.

➠When removing or installing the constant tension hose clamps from vehicles so equipped, use only the correct clamp tool, such as the Snap-On No. HPC–20, or equivalent.

2. Loosen all accessories that are belt driven and remove the belt(s).
3. On engines without air conditioning, remove the alternator bracket attaching bolts and tie the alternator and bracket out of the way.
4. On engines with air conditioning, remove the idler pulley assembly, alternator, and adjusting bracket.
5. Remove the fan blade, spacer (or fluid unit), pulley, and bolts as an assembly.

➠To prevent silicone fluid from draining into the drive bearing and ruining the lubricant, do not place the thermostatic fan drive unit with the shaft pointing downward.

6. Disconnect all hoses from the water pump.
7. Remove the air conditioning compressor front mounting bolts.
8. Remove the water pump-to-compressor front bracket bolts and the bracket. Remove the water pump.

➠Do not disconnect any refrigerant lines from the compressor.

9. Installation is the reverse of removal. Secure the water-pump-to-compressor front bracket mounting bolts. Tighten the bolts to 30 ft. lbs. (41 Nm).
10. Install the radiator. Fill the cooling system and adjust the tension of the drive belt(s).

8.0L Engine

➧ See Figures 69, 70 and 71

1. Disconnect the negative battery cable.
2. Drain the cooling system.
3. Remove the washer bottle from the fan shroud and disconnect the fan shroud but do not remove it from the radiator.
4. Remove the upper radiator hose from the radiator.

➠When removing or installing the constant tension hose clamps from vehicles so equipped, use only the correct clamp tool, such as the Snap-On No. HPC–20, or equivalent.

5. Remove the fan blade, spacer (or fluid unit), pulley, and bolts as an assembly.

➠To prevent silicone fluid from draining into the drive bearing and ruining the lubricant, do not place the thermostatic fan drive unit with the shaft pointing downward.

6. Loosen all accessories that are belt driven and remove the belt.
7. Remove the four water pump pulley-to-water pump hub bolts and remove the pulley from the vehicle.
8. Remove the lower radiator hose from the water pump.
9. Remove the heater hose at the water pump fitting.
10. Remove the seven water pump mounting bolts.
11. Loosen the clamp at the water pump end of the bypass hose. Slip the hose from the water pump while removing the pump from the vehicle. Do not remove the clamp from the bypass hose.
12. Discard the water pump-to-timing chain/case/cover O-ring seal.
13. Remove the heater hose fitting from the water pump if the pump replacement is necessary. Note the position (direction) of the fitting before removal. The fitting must be installed in the same position.

➠Do not disconnect any refrigerant lines from the compressor.

To install:

➠This component is subjected to constant high pressure from hot fluid and must be sealed correctly or it will leak.

14. Clean the mating surfaces prior to sealing the water pump.
15. Install the water pump on the engine. Use a new gasket coated with sealer.
16. Attach the water-pump-to-compressor front bracket mounting bolts and tighten to 30 ft. lbs. (41 Nm).
17. If a new pump has been installed, then install the heater hose fitting to the pump. Tighten the fitting to 144 inch lbs. (16 Nm). After the fitting is tightened, position it as shown in the drawing. When positioning the fitting, do not back it off (rotate counterclockwise). Use a suitable Teflon®containing thread sealant. Refer to the directions on the package.
18. The remainder of installation is the reverse of removal. Tighten the water pump bolts to 30 ft. lbs. (40 Nm).
19. Install the water pump pulley. Tighten the bolts to 16 ft. lbs. (22 Nm). Place a prybar between the water pump pulley bolts to prevent the pulley from relaxing.
20. Fill the cooling system, start the vehicle and check for leaks.

Diesel Engine

1. Disconnect the negative battery cable.
2. Drain the coolant.
3. Use a ⅜ in. drive breaker bar to lift the belt tensioner and remove the belt.
4. Remove the two water pump retaining bolts and remove the pump from the engine.
5. Remove the O-ring from the pump groove.
6. Installation is the reverse of removal. Tighten the mounting bolts to 18 ft. lbs. (24 Nm). Fill the radiator with coolant.
7. Run the vehicle until the thermostat opens, fill the radiator completely and check for leaks.
8. Once the vehicle has cooled, recheck the coolant level.

Cylinder Head

REMOVAL & INSTALLATION

2.5L Engine

➧ See Figures 72 and 73

1. Relieve the fuel system pressure.
2. Disconnect the negative battery cable and unbolt it from the head.

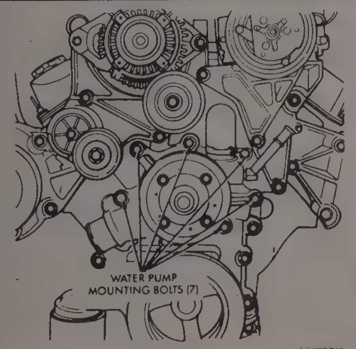


Fig. 69 Remove/install the water pump bolts shown—V10 engine

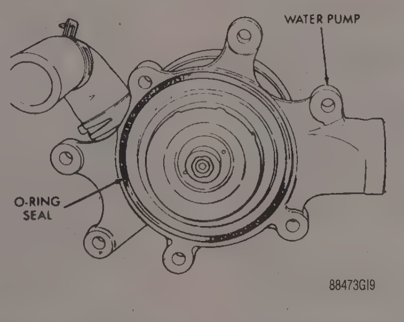


Fig. 70 Details of the water pump O-ring seal—V10 engine

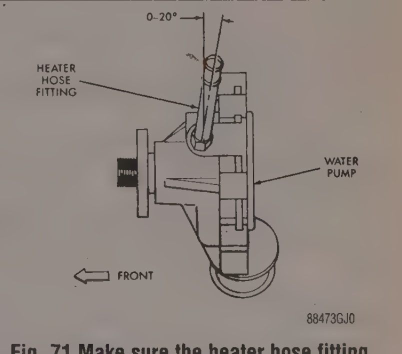


Fig. 71 Make sure the heater hose fitting is positioned as shown for correct mounting—V10 engine

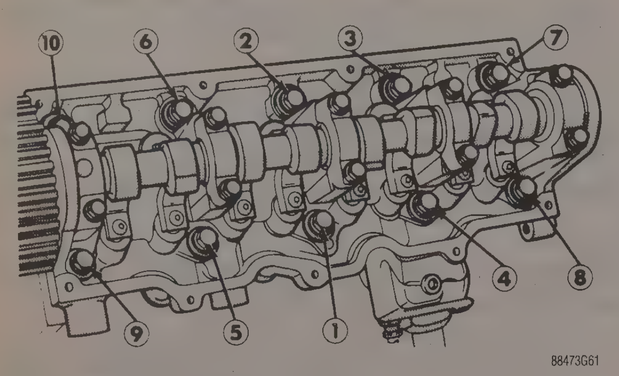


Fig. 72 Cylinder head tightening sequence—2.5L engine

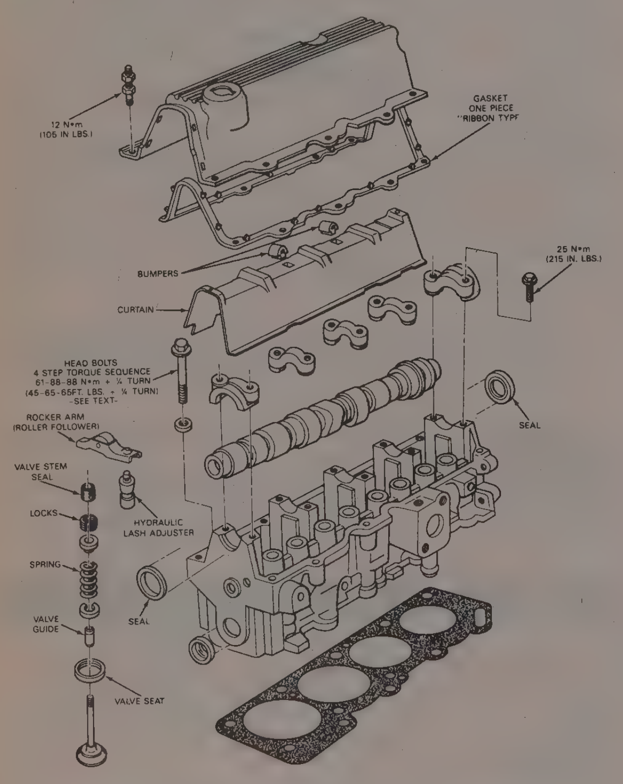


Fig. 73 Exploded view of the entire cylinder head assembly—2.5L engine

3. Drain the cooling system. Remove the dipstick bracket nut from the thermostat housing.

4. Remove the air cleaner assembly. Remove the upper radiator hose and disconnect the heater hoses.

5. Disconnect and label the vacuum lines, hoses and wiring connectors from the manifold(s), throttle body and from the cylinder head. Remove the air pump, if equipped.

6. Disconnect the all linkages and the fuel line from the throttle body. Unbolt the cable bracket. Remove the ground strap attaching screw from the firewall.

7. If equipped with air conditioning, remove the upper compressor mounting bolts. The cylinder head can be removed with the compressor and bracket still mounted. Remove the upper part of the timing belt cover.

8. Raise the vehicle and support safely. Disconnect the converter from the exhaust manifold. Disconnect the water hose and oil drain from the turbocharger, if equipped.

9. Rotate the engine by hand, until the timing marks align (No. 1 piston at TDC). Lower the vehicle.

10. With the timing marks aligned, remove the camshaft sprocket. The camshaft sprocket can be suspended to keep the timing intact. Remove the spark plug wires from the spark plugs.

11. Remove the cylinder head cover and curtain, if equipped. Remove the cylinder head bolts and washers, starting from the middle and working outward.

12. Remove the cylinder head from the engine.

To install:

➡Before disassembling or repairing any part of the cylinder head assembly, identify factory installed oversized components. To do so, look for the tops of the bearing caps painted green and O/SJ stamped rearward of the oil gallery plug on the rear of the head. In addition, the barrel of the camshaft is painted green and O/SJ is stamped onto the rear end of the camshaft. Installing standard sized parts in a head equipped with oversized parts-or visa versa-will cause severe engine damage.

13. Clean the cylinder head gasket mating surfaces.

14. Using new gaskets and seals, install the head to the engine.

15. Using new head bolts assembled with the old washers, tighten the cylinder head bolts in sequence, to 45 ft. lbs. (61 Nm). Repeating the sequence, tighten the bolts to 65 ft. lbs. (88 Nm). With the bolts at 65 ft. lbs. (88 Nm), turn each bolt an additional 1/4 turn.

➡Head bolt diameter is 11mm. These bolts are identified with the number 11 of the head of the bolt. The 10mm bolts used on some earlier vehicles will thread into an 11mm bolt hole, but will permanently damage the cylinder block. Make sure the correct bolts are being used when replacing old head bolts.

16. Install the timing belt and all items that were removed or disconnected during the removal procedure.

17. Refill the cooling system. Connect the negative battery cable. Start the engine and check for leaks.

3.9L Engine

➧ See Figures 74 thru 81

1. Relieve the fuel pressure. Disconnect the negative battery cable from the battery and drain the cooling system.

2. Raise the vehicle and safely support. Disconnect the exhaust pipe from the manifolds.

3. Remove the alternator if the right head is being removed and the air pump and negative battery cable if the left head is being removed.

4. Remove the air cleaner assembly. Unbolt the air conditioning compressor and lay it to the side, if equipped. Remove the distributor cap with all wires attached.

5. Disconnect all wires, hoses, linkages and cables from the throttle body. Disconnect and plug the fuel line.

6. Disconnect the ignition coil, coolant temperature sending unit wire and all other connectors along the wiring harness connected to items on the intake manifold.

7. Disconnect the heater hose, upper radiator hose and the lower bypass hose clamp.

8. Remove the cylinder head covers.

9. Remove the intake manifold assembly. Remove the exhaust manifolds.

10. Remove the rocker arm and shaft assembly from the heads. Do not disassemble unless service is required.

11. Remove the pushrods and identify them to ensure installation in their original locations.

12. Remove the head bolts and remove the cylinder head(s).

To install:

13. Clean and dry all gasket surfaces of the cylinder block and head. Inspect all surfaces with a straightedge. If the flatness exceeds 0.0075 times the length of the span measured (in any direction), replace or machine the head gasket surface.

14. Using no sealer whatsoever, install the new head gasket(s) to the block. Clean, dry and lightly oil all head bolts threads. Install the heads and install the head bolts.

15. Tighten the head bolts in sequence to 50 ft. lbs. (68 Nm). Repeat the sequence retightening the bolts to a final torque of 105 ft. lbs. (143 Nm) and repeat the second step to ensure that all bolts are accurately torqued.

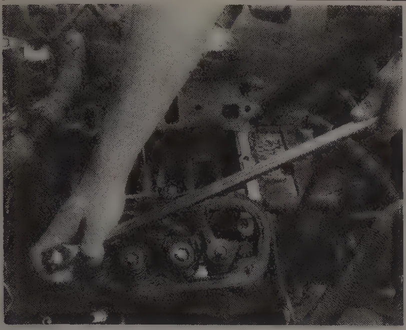

88473P30

Fig. 74 Use a breaker bar to remove the cylinder head bolts

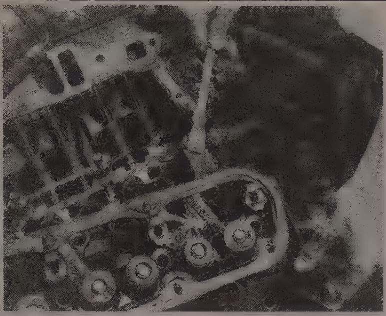

88473P31

Fig. 75 If necessary, a prybar may be used to gently pry the cylinder head from the block

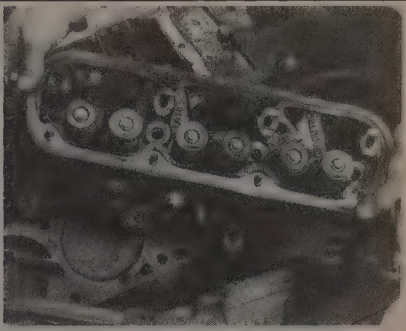

88473P32

Fig. 76 Remove the cylinder head and set it in a clean, safe place

88473P81

Fig. 77 Remove the pushrods one-by-one—label them to enable reinstallation in the correct order

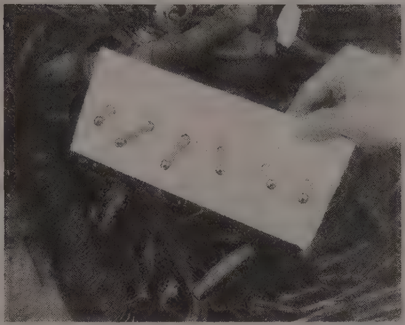

88473P82

Fig. 78 A sturdy piece of cardboard makes an ideal organizer for the pushrods

88473P34

Fig. 79 Scrape all old gasket material from the mating surfaces, taking care not to damage them

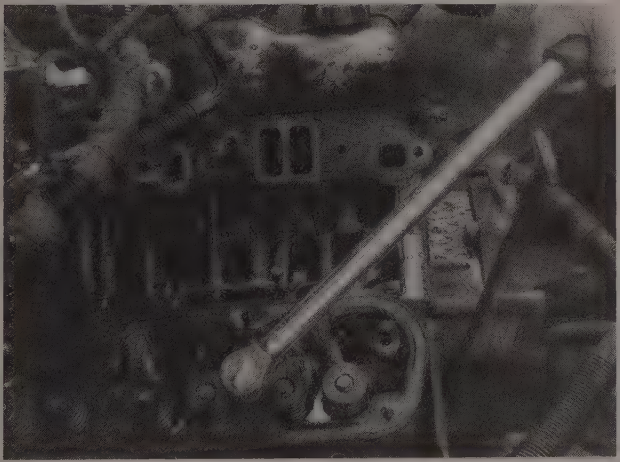
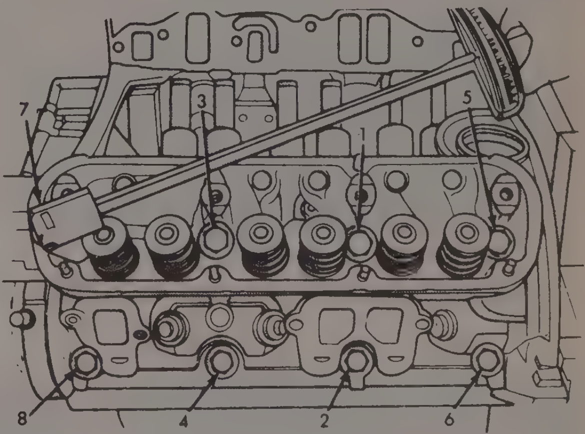

88473P35

Fig. 80 Tighten the cylinder head bolts with a torque wrench to the proper specification



88473G62

Fig. 81 Cylinder head tightening sequence—V6 engine

16. Assemble the rocker shaft assembly, if it was serviced. Make sure all rocker arms with an RH stamped on them are installed to the right of those with an LH. Install the pushrods, rocker arms and shaft(s) with the notch on the rear of the right bank or to the font of the left bank. Make sure the long stamped steel retainers are at the number 2 and 4 positions. Tighten the bolts evenly and gradually to 117 ft. lbs. (23 Nm).
17. The remainder of installation is the reverse of removal. Tighten each component to specifications.
18. Fill the cooling system.
19. Connect the negative battery cable and set all adjustments to specification.

5.2L and 5.9L Engines

➧ See Figure 82

1. Drain the cooling system and disconnect the negative battery cable.
2. Remove the alternator, air cleaner, fuel line and any obstructing heat shields.
3. Disconnect the accelerator linkage.
4. Remove the vacuum lines from the throttle body. On trucks with the 5.9L engine, remove the battery.
5. Remove the distributor cap and wires as an assembly.

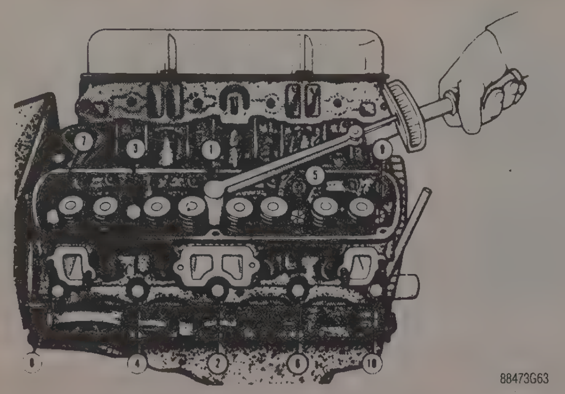


Fig. 82 Cylinder head tightening sequence—V8 engines

6. Disconnect the coil wires, water temperature sending unit, heater hoses, and bypass hose. On the 5.9L engine, remove the distributor.
7. Remove the closed ventilation system, the evaporative control system, and the cylinder head covers.
8. Remove the intake manifold.
9. Remove the exhaust manifolds.
10. On 5.9L engines, tag the center bolts.
11. Remove the tappet chamber cover. Remove the rocker and shaft assemblies.
12. Remove the pushrods and keep them in order to ensure installation in their original locations. On the 5.9L engine, remove the water pump-to-head bolts.
13. Remove the head bolts from each cylinder head and remove the cylinder heads.
14. Clean all the gasket surfaces of the engine block and the cylinder heads. Install the spark plugs.
15. Inspect all surfaces with a straightedge. If warpage is indicated, measure the amount. This amount must not exceed 0.00075 times the span length in any direction. For example, if a 12 in. (305mm) span is 0.004 in. (0.10mm) warped, the maximum allowable difference is 12 x 0.00075 = 0.009 in. (305 x 0.00075 = 0.22875mm). In this case, the head is within limits. If the warpage exceeds the specified limits, either replace the head or lightly machine the head gasket surface.

To install:

16. Coat new cylinder head gaskets with sealer, install the gaskets and install the cylinder heads.
17. Install the cylinder head bolts. Tighten the cylinder head bolts to 105 ft. lbs. (143 Nm) in the sequence indicated. Repeat this sequence to re-torque all the cylinder head bolts to specifications.
18. Install the pushrods.
19. The remainder of installation is the reverse of removal. Tighten each component to specifications.
20. Fill the cooling system and connect the negative battery cable.

8.0L Engine

➧ See Figures 83, 84 and 85

1. Drain the cooling system and disconnect the negative battery cable.
2. Remove the heat shields.
3. Remove the intake manifold-to-alternator bracket support rod. Remove the alternator.
4. Disconnect the accelerator linkage.
5. Remove the closed ventilation system, the evaporative control system, and the cylinder head covers.
6. Disconnect the evaporation control system.
7. Remove the air cleaner.
8. Relieve the fuel system pressure.
9. Disconnect the throttle linkage and the speed control and transmission kickdown cables, if equipped.
10. Remove the coil pack and bracket.
11. Disconnect the coil wires.
12. Disconnect the heat indicator sending unit wire.
13. Disconnect the heater hoses and bypass hose.
14. Remove the upper intake manifold and throttle body as an assembly.
15. Remove the cylinder head covers and (reusable) gaskets.
16. Remove the EGR tube. Discard the gasket for right side only.
17. Remove the lower intake manifold. Discard the flange side gaskets and the front and rear cross-over gaskets.
18. Disconnect the exhaust pipe from the exhaust manifold.
19. Remove rocker arm assemblies and pushrods. Organize them so as to be able to install them in the exact same location.
20. Remove the head bolts from each cylinder head and remove the cylinder heads. Discard the gasket.
21. Remove the spark plugs.
22. Clean all the gasket surfaces of the engine block and the cylinder heads.
23. Inspect all surfaces with a straightedge. If warpage is indicated, measure the amount. The out-of-flatness specifications are 0.0004 in. per 1 in. (0.0007mm per 1mm) or 0.005 in. per 6 in. (0.127mm per 152mm) in any direction, or 0.010 in. (0.254mm) overall across the head. If exceeded, either replace the head, or machine the surface to skim it flat. The cylinder head surface finish should be 15–80 microinches (1.78–4.57 microns).

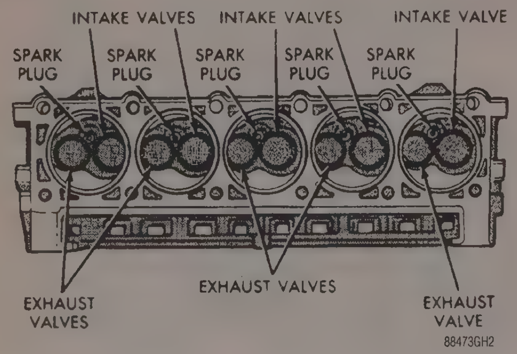


Fig. 83 Details of the cylinder head assembly

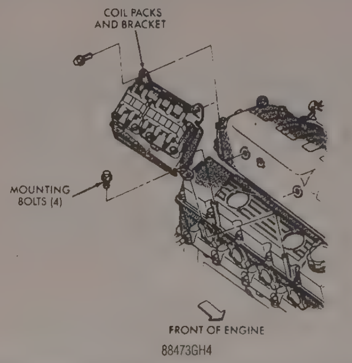


Fig. 84 Remove the coil pack and bracket to access the cylinder head assembly

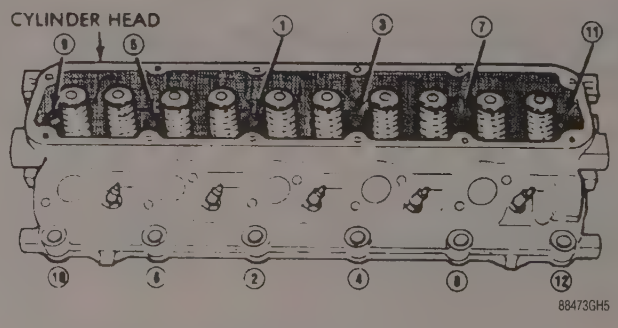


Fig. 85 Cylinder head tightening sequence—V10 engines

To install:

24. Install the gaskets and install the cylinder heads.
25. Install the cylinder head bolts. Tighten the cylinder head bolts in two steps:
- Tighten all cylinder head bolts in sequence to 43 ft. lbs. (58 Nm).
- Tighten all cylinder head bolts in sequence to 105 ft. lbs. (143 Nm).
26. Install the pushrods and rocker arm assemblies in their original positions. Tighten the bolts to 21 ft. lbs. (28 Nm).
27. The remainder of installation is the reverse of removal. Tighten each component to specifications.

❖❖ WARNING

Make absolutely sure the block sealing surface is free of oil.

28. Align the slots in the end seals with the notches in the intake manifold.
29. Insert Mopar®Silicone Rubber Adhesive Sealant, or equivalent, into the four corner pockets. Fill—without overfilling—the pockets.
30. Install the lower intake manifold within NO MORE THAN three minutes of applying the sealant. Carefully lower the intake manifold into position on the cylinder block and heads. After the intake manifold is in place, inspect to make sure the seals and gaskets are in place.
- Lower intake manifold bolts—40 ft. lbs. (54 Nm)
- Upper intake manifold—16 ft. lbs. (22 Nm)
- EGR tube nut—25 ft. lbs. (34 Nm)
- EGR tube bolts—174 inch lbs. (20 Nm)
- Heat shield nuts—132 inch lbs. (15 Nm)
- Coil packs and bracket bolts—190 inch lbs. (21 Nm)
31. Fill the cooling system. Start the truck and check for any leaks.

Diesel Engine

➧ See Figures 86 and 87

1. Disconnect the negative battery cable.
2. Drain the coolant.
3. Disconnect the radiator hose and heater hoses.
4. Remove the turbocharger and air crossover.
5. Remove the exhaust manifold.
6. Remove all fuel lines from the injection pump and injector nozzles. Remove the fuel filter.

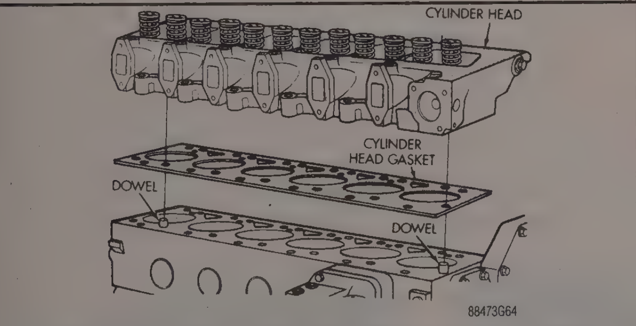


Fig. 86 Align the cylinder head gasket with the dowels as shown—diesel engine

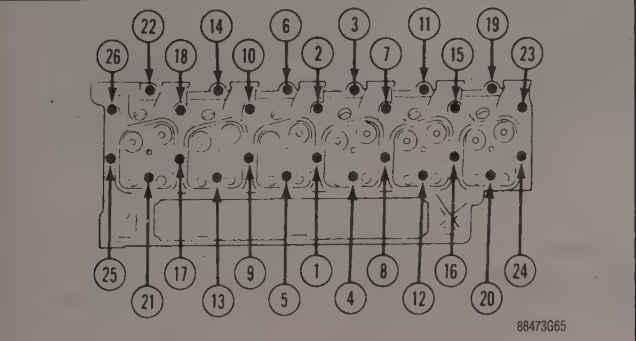


Fig. 87 Cylinder head tightening sequence—diesel engine

7. Remove the cylinder head covers.
8. Remove the rocker arms and pushrods.
9. Unbolt the cylinder head from the block. Remove the cylinder head.
10. Inspect the coolant passages. A large accumulation of rust or lime will require service to the block.
11. Inspect the surface of the head for flatness. The maximum variation is 0.0004 in. (0.010mm) within any 2 in. (50mm) diameter area or 0.012 in. (0.30mm) overall end-to-end or side-to-side.

To install:

12. Thoroughly clean and dry the mating surfaces of the head and block. Position the new head gasket on the dowels.
13. Install the head onto the dowels on the block. Lubricate the pushrod sockets and install the pushrods and rocker arms.
14. Clean, dry and lightly lubricate the head bolts. Install and tighten in sequence first to 29 ft. lbs. (40 Nm), then to 62 ft. lbs. (85 Nm) and finally to 93 ft. lbs. (126 Nm).
15. Install the rocker arm pedestal bolts. Tighten to 18 ft. lbs. (85 Nm) and finally to 93 ft. lbs. (126 Nm).
16. Adjust the valve clearance, install the cylinder head covers with new gaskets. Tighten the bolts to 18 ft. lbs. (24 Nm).
17. The remainder of installation is the reverse of removal.

CLEANING AND INSPECTION

➧ See Figures 88 and 89

1. With the valves installed to protect the valve seats, remove deposits from the combustion chambers and valve heads with a scraper and a wire brush. Be careful not to damage the cylinder head gasket surface. After the valves are

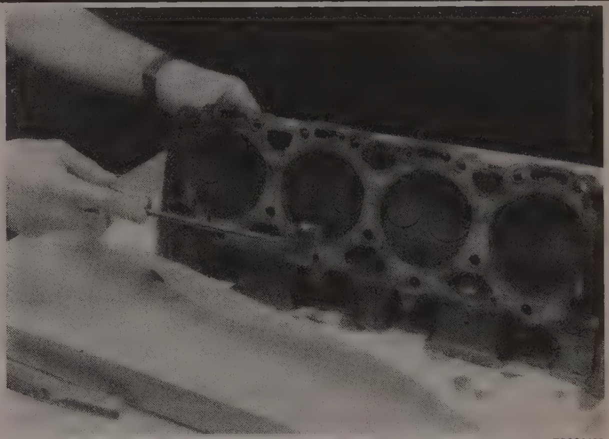


Fig. 88 Use a gasket scraper to remove the bulk of the old head gasket from the mating surface

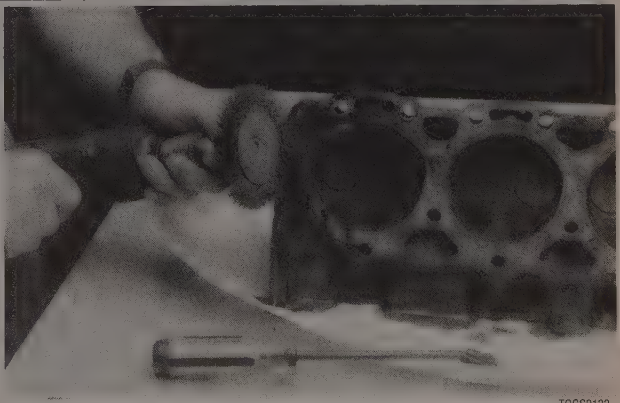


Fig. 89 An electric drill equipped with a wire wheel will expedite complete gasket removal

removed, clean the valve guide bores with a valve guide cleaning tool. Using cleaning solvent to remove dirt, grease and other deposits, clean all bolt holes; be sure the oil passage is clean (V8 engine).

2. Remove all deposits from the valves with a fine wire brush or buffing wheel.
3. Inspect the cylinder heads for cracks or excessively burned areas in the exhaust outlet ports.
4. Check the cylinder head for cracks and inspect the gasket surface for burrs and nicks. Replace the head if it is cracked.
5. On cylinder heads that incorporate valve seat inserts, check the inserts for excessive wear, cracks, or looseness.

RESURFACING

➧ See Figures 90 and 91

When the cylinder head is removed, check the flatness of the cylinder head gasket surfaces.

1. Place a straightedge across the gasket surface of the cylinder head gasket surfaces.
2. If warpage exceeds 0.003 in. (0.076mm) in a 6 in. (152.4mm) span, or 0.006 in. (0.15mm) 0.008 in. (0.20mm) for the diesel over the total length, the cylinder head must be resurfaced.
3. If necessary to refinish the cylinder head gasket surface, do not grind off more than 0.010 in. (0.25mm) from a gasoline engine cylinder head, or more than 0.03937 in. (1mm) for the diesel engine.

➡When milling the cylinder heads of V6 and V8 engines, the intake manifold mounting position is altered, and must be corrected by milling the manifold flange a proportionate amount. Consult an experienced machinist about this.

Valves

REMOVAL & INSTALLATION

➧ See Figure 92

1. Remove the cylinder head from the vehicle.
2. Block the head on its side, or install a pair of head-holding brackets made especially for valve removal.
3. Use a socket slightly larger than the valve stem and keepers, place the socket over the valve stem and gently hit the socket with a soft faced hammer to break loose any varnish buildup.
4. Remove the valve keepers, retainer, spring shield and valve spring using a valve spring compressor.
5. Remove the valves from the cylinder head and place them, in order, through numbered holes punched in a stiff piece of cardboard or wood valve holding stick.

➡The exhaust valve stems, on some engines, may be equipped with small metal caps. Take care not to lose the caps. Make sure to reinstall them at assembly time. Replace any caps that are worn.

6. Put the parts in a container numbered for the cylinder being worked on; do not mix them with other parts removed.
7. Installation is the reverse of removal.

CLEANING AND INSPECTION

➧ See Figures 93, 94 and 95

➡There is some overlap of the steps in this procedure with the steps in the cylinder head cleaning and inspection procedure. If you have followed that procedure already, disregard the redundant steps here as you deem acceptable.

1. Remove and discard the valve stem oil seals. A new seal will be used at assembly time.
2. Use an electric drill and rotary wire brush to clean the intake and exhaust valve ports, combustion chamber and valve seats. In some cases, the carbon will need to be chipped away. Use a blunt pointed drift for carbon chipping. Be careful around the valve seat areas.
3. Use a wire valve guide cleaning brush and safe solvent to clean the valve guides.
4. Clean the valves with a revolving wire brush. Heavy carbon deposits may be removed with a blunt drift.

➡When using a wire brush to clean carbon on the valve ports, valves etc., be sure that the deposits are actually removed, rather than burnished.

5. Wash and clean all valve springs, keepers, retaining caps etc., in safe solvent.
6. Clean the head with a brush and some safe solvent, then wipe dry.
7. Check the head for cracks. Cracks in the cylinder head usually start around an exhaust valve seat because it is the hottest part of the combustion chamber. If a crack is suspected but cannot be detected visually have the area checked with dye penetrant or other method by a machine shop.
8. After all cylinder head parts are reasonably clean, check the valve stem-to-guide clearance. If a dial indicator is not on hand, a visual inspection can give you a fairly good idea if the guide, valve stem or both are worn. Use a dial indicator to be sure.
9. Insert the valve into the guide, slightly away from the valve seat. Wiggle the valve sideways. A small amount of wobble is normal, excessive wobble means a worn guide or valve stem. If a dial indicator is on hand, mount the indicator so that the stem of the valve is at 90°to the valve stem, as close to the valve guide as possible. Move the valve off the seat, and measure the valve guide-to-stem clearance by rocking the stem back and forth to actuate the dial indicator. Measure the valve stem using a micrometer and compare to specifications to determine whether stem or guide wear is causing excessive clearance.

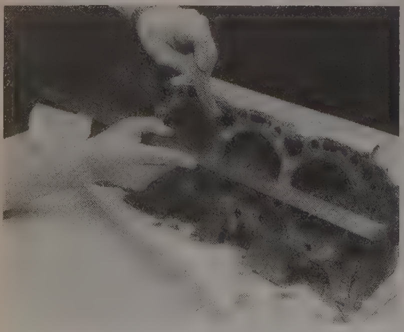

TCCS3134

Fig. 90 Check the cylinder head for warpage along the center using a straightedge and a feeler gauge

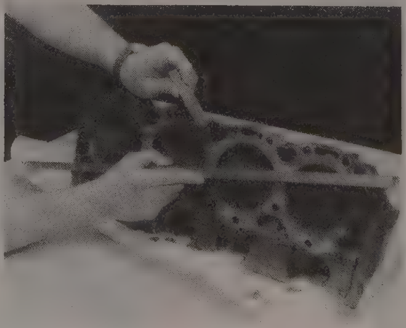

TCCS3135

Fig. 91 Be sure to check for warpage across the cylinder head at both diagonals

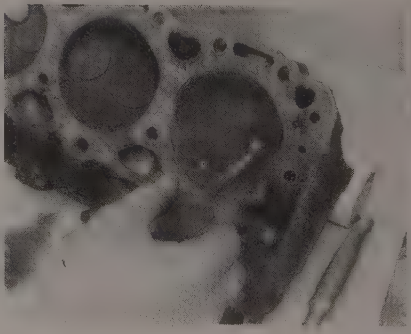

TCCS3141

Fig. 92 Invert the cylinder head and withdraw the valve from the cylinder head bore

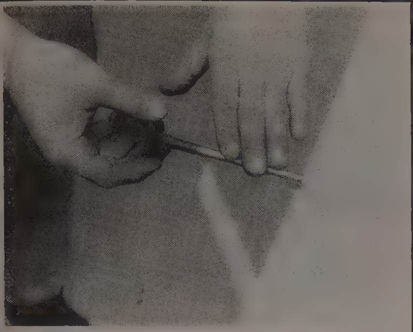


Fig. 93 Valve stems may be rolled on a flat surface to check for bends

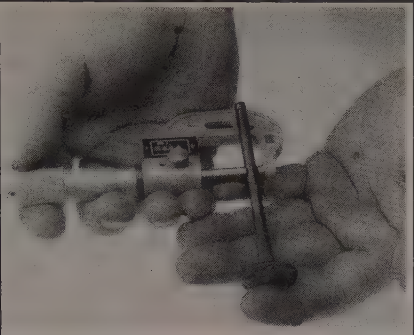


Fig. 94 Use a micrometer to check the valve stem diameter

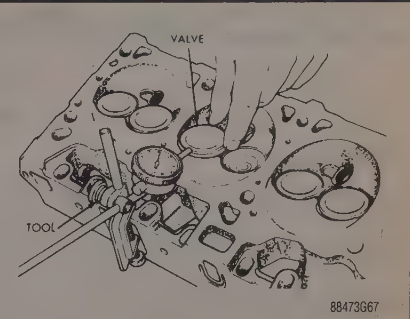

VALVE
TOOL
88473G67

Fig. 95 Use a dial gauge for greatest precision when measuring the valve guide wear

REFACING

➧ See Figures 96, 97, 98, 99 and 100

1. The valve guide, if worn, must be repaired before the valve seats can be resurfaced. Chrysler supplies valves with oversize stems to fit valve guides that are reamed to oversize for repair. A machine shop will be able to handle the guide reaming for you. In some cases, if the guide is not too badly worn, knurling may be all that is required.
2. The valve seats should be a true 45°angle. Remove only enough metal to clean up the valve face or to correct run-out. If the edge of a valve head, after machining, is 1⁄32 in.(0.8mm) or less, replace the valve. The tip of the valve stem should also be dressed on the valve grinding machine, however, do not remove more than 0.010 in. (0.254mm). If necessary, have a machine shop resurface the valves and seats. Remove only enough material to clean up any pits or grooves. Be sure the valve seat is not too wide or narrow.
3. After the valves are refaced by machine, they may have to be hand lapped. Check with your machine shop whether this operation is necessary. In many cases, it is not necessary due to the greater degree of precision in today's machining operations, and also for the fact that some hardened valve seat materials cannot be hand lapped. If the machine shop recommends it, hand lap them with grinding compound. Clean the grinding compound off and check the position of face-to-seat contact. Contact should be close to the center of the valve face. If contact is close to the top edge of the valve, narrow the seat; if too close to the bottom edge, raise the seat.
4. After all valve and valve seats have been machined, check the remaining valve train parts (springs, retainers, keepers, etc.) for wear. Check the valve springs for straitness and tension.

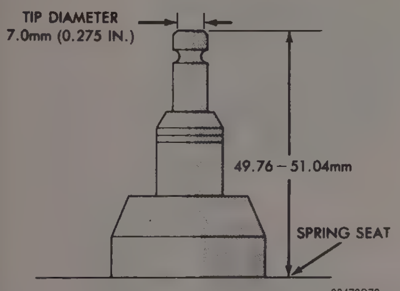

TIP DIAMETER
7.0mm (0.275 IN.)
49.76 – 51.04mm
SPRING SEAT
88473G70

Fig. 96 Valve tip-to-valve spring seat dimensions—2.5L engine

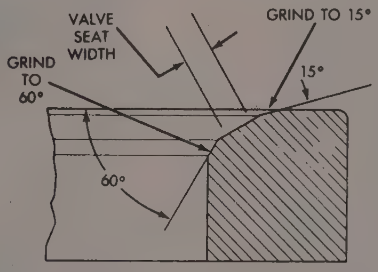

VALVE SEAT WIDTH
GRIND TO 15°
GRIND TO 60°
15°
60°
88473G73

Fig. 97 The valve seats should be ground along the critical dimensions in the drawing—diesel engine shown

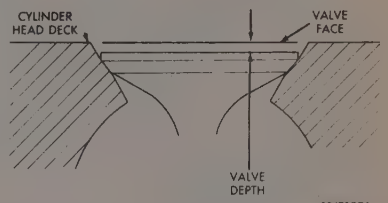

CYLINDER HEAD DECK
VALVE FACE
VALVE DEPTH
88473G74

Fig. 98 The valve depth is measured along the dimensions indicated—diesel engine valve shown

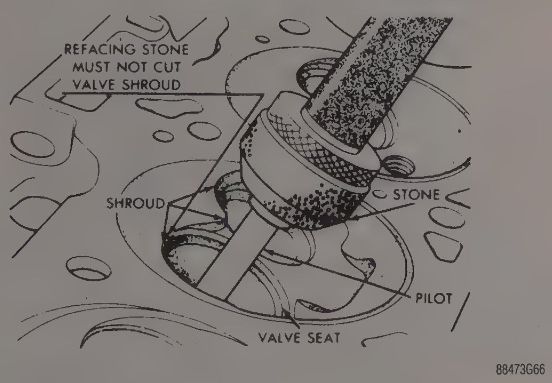

REFACING STONE MUST NOT CUT VALVE SHROUD
SHROUD
STONE
PILOT
VALVE SEAT
88473G66

Fig. 99 Refacing the valve seats

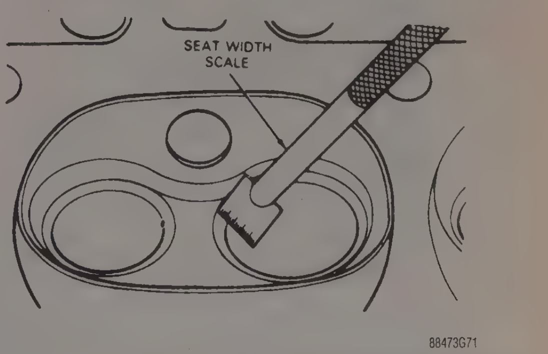

SEAT WIDTH SCALE
88473G71

Fig. 100 The valve seat width is measured with a special scale like the one shown

Valve Stem Seal

REMOVAL & INSTALLATION

Gasoline Engines

➧ See Figures 101, 102, 103, 104 and 105

If valve stem oil seals are found to be the cause of excessive oil consumption, they may be replaced without removing the cylinder block.

➡This procedure calls for leaving the cylinder head installed. You will need a source of compressed air and a screw-in adapter for the spark plug hole.

1. Remove the air cleaner.
2. Remove cylinder head covers and spark plugs.
3. Detach the coil wire from the distributor.
4. Turn the engine so that No. 1 cylinder is at Top Dead Center on the compression stroke. Both valves for No. 1 cylinder should be fully closed and the crankshaft damper timing mark at TDC. The distributor rotor will point at the No. 1 spark plug wire location in the cap.
5. Remove the rocker shaft and install a dummy shaft.
6. Apply 90–100 psi (620–689 kPa) air pressure to No. 1 cylinder, using a spark plug hole air hose adaptor.
7. Use a valve spring compressor to compress each No. 1 cylinder valve spring and remove the retainer locks and the spring. Remove the old seals.
8. Install a cup shield on the exhaust valve stem. Position it down against the valve guide.

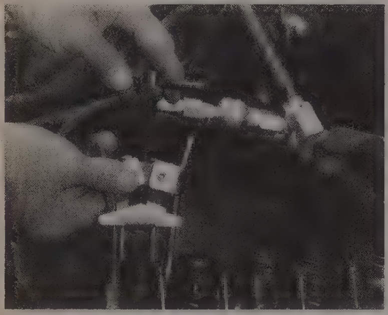

88473P46

Fig. 101 Use a valve spring compressor tool to relieve spring tension from the valve caps

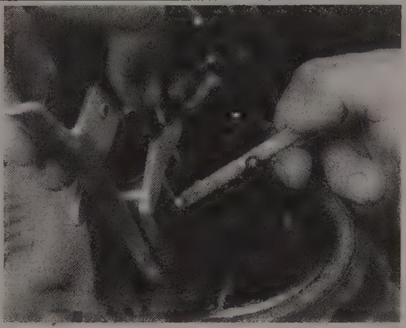

88473P47

Fig. 102 A small magnet will help in removal of the valve keepers

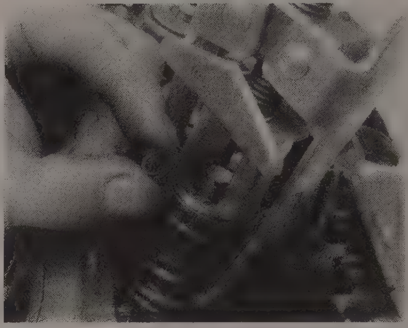

TCCS3139

Fig. 103 Be careful not to lose the valve keepers

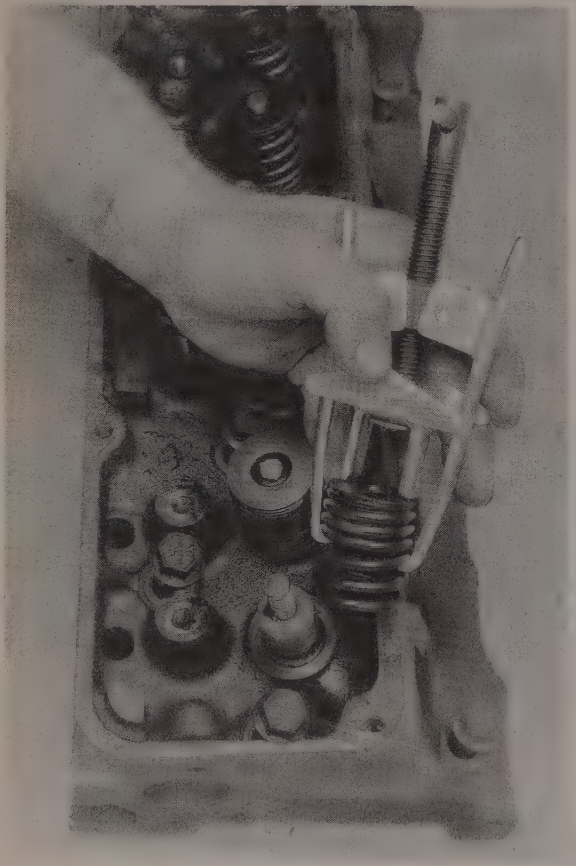

TCCS3810

Fig. 104 Remove the spring from the valve stem in order to access the seal

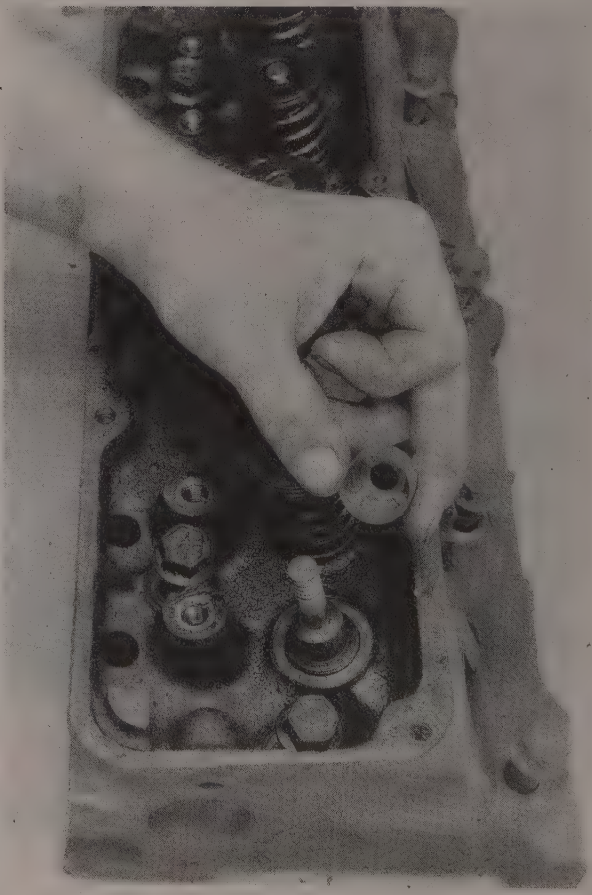

TCCS3811

Fig. 105 Remove the valve stem seal from the cylinder head

9. Push the intake valve stem seal firmly and squarely over the valve guide.
10. Compress the valve spring only enough to install the lock.
11. Repeat the operation on each successive cylinder in the firing order, making sure that the crankshaft is exactly on TDC for each cylinder. See the Firing Order and Distributor Rotation illustrations in Section 2.
12. Replace the rocker arms, covers, spark plugs and coil wire.

Valve Springs

REMOVAL & INSTALLATION

▶ See Figures 106 and 107

1. Block the head on its side, or install a pair of head-holding brackets made especially for valve removal.
2. Use a socket slightly larger than the valve stem and keepers, place the socket over the valve stem and gently hit the socket with a plastic hammer to break loose any varnish buildup.
3. Remove the valve keepers, retainer, spring shield and valve spring using a valve spring compressor (the locking C-clamp type is the easiest kind to use).
4. Put the parts in a separate container numbered for the cylinder being worked on; do not mix them with other parts removed.
5. Remove and discard the valve stem oil seals. A new seal will be used at assembly time.
6. Installation is the reverse of removal. Check the valve spring installed height, shim or replace as necessary.

INSPECTION

▶ See Figures 108, 109 and 110

Place the valve spring on a flat surface next to a carpenter's square. Measure the height of the spring, and rotate the spring against the edge of the square to measure distortion. If the spring height varies (by comparison) by more than 1⁄16 in.(1.6mm) or if the distortion exceeds 1⁄16 in.(1.6mm), replace the spring. Have the valve springs tested for spring pressure at the installed and compressed (installed height minus valve lift) height using a valve spring tester. Springs should be within one pound, plus or minus each other. Replace as necessary.

VALVE SPRING INSTALLED HEIGHT

▶ See Figure 111

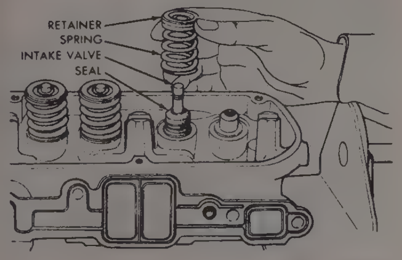
After installing the valve spring, measure the distance between the spring mounting pad and the lower edge of the spring retainer. Compare the measurement to specifications. If the installed height is incorrect, add shim washers between the spring mounting pad and the spring. Use only washers designed for valve springs, available at most auto parts stores.

Valve Seats

REMOVAL & INSTALLATION

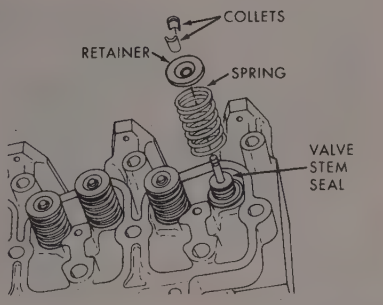
▶ See Figure 112

If the valve seat is damaged or burnt and cannot be serviced by refacing, it may be possible to have the seat machined and an insert installed. Consult an automotive machine shop for their advice. Diesel engine valve seats can be ground only once. If the seat has been reground, service seats must be installed. One X stamped into the head identifies that the seats have been refaced. If the wall stamp is XX, it means service has been installed. Service seats can be reground. If you remove more than 0.010 in. (0.254mm) from the cylinder head combustion surface, install service seats. Measure the head height to determine if service seats are necessary. Check the rear lower right corner of the head for a stamping that would indicate previous resurfacing. The valve depth limit is 0.010 in. (0.254mm).



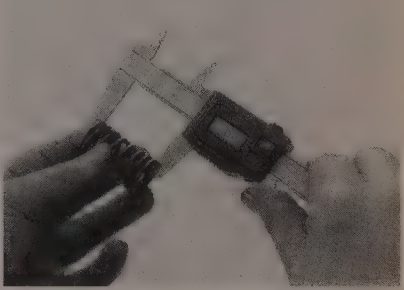
88473G68

Fig. 106 Install the valve, cup, seal and retainer—V6 and V8 engines shown



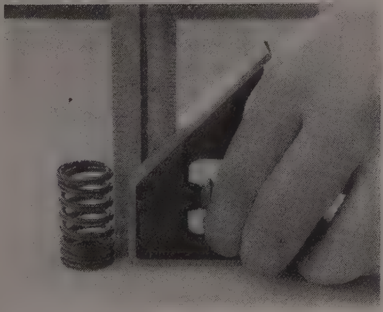
88473G75

Fig. 107 Exploded view of the valve springs and retainer as used on the diesel engine



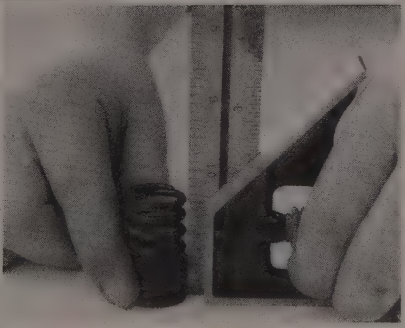
TCCS3907

Fig. 108 Use a caliper gauge to check the valve spring free-length



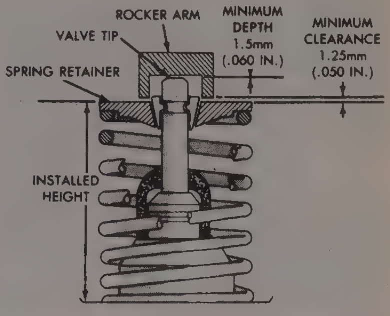
TCCS3908

Fig. 109 Check the valve spring for squareness on a flat service; a carpenter's square can be used



TCCS3909

Fig. 110 The valve spring should be straight up and down when placed like this


ROCKER ARM
MINIMUM DEPTH 1.5mm (.060 IN.)
MINIMUM CLEARANCE 1.25mm (.050 IN.)
VALVE TIP
SPRING RETAINER
INSTALLED HEIGHT

88473G69

Fig. 111 Check the spring installed height and spring clearance—2.5L engine specifications shown

Valve Guides

REMOVAL & INSTALLATION

Gasoline Engines

▶ See Figure 113

Worn valve guides can, in most cases, be reamed to accept a valve with an oversized stem. Valve guides that are not excessively worn or distorted may, in some cases, be knurled rather than reamed. However, if the valve stem is worn reaming for an oversized valve stem is the answer since a new valve would be required. Knurling is a process in which metal is displaced and raised, thereby reducing clearance. Knurling also produces excellent oil control. The possibility of knurling instead of reaming the valve guides should be discussed with a machinist.

Diesel Engine

Diesel engine valve guide bores have a wear limit of 0.3815 in. (9.7mm). If the valve guide bores are larger than the wear limit, the cylinder head must be machined for service valve guides. Consult a machinist.

Valve Lifters

➡The hydraulic valve lifters are also known as "tappets," and this term will be used interchangeably in this manual.

REMOVAL & INSTALLATION

2.5L Engine

1. Disconnect the negative battery cable.
2. Remove the cylinder head cover.
3. For each rocker arm, rotate the cam until the base circle is in contact with the rocker arm. Depress the valve spring using tool No. MD–998772A. Slide the rocker arm out. Keep all rocker arms in order for installation in the exact same sequence.
4. Remove the hydraulic valve lifter.

To install:

5. Install the hydraulic lifters. Make sure that the adjusters are at least partially full of oil.
6. Rotate the cam until the base circle is in contact with the rocker arm. Depress the valve spring and slide the rocker arm in place.

➡Keep the rockers in the original order. It is possible for the valve spring retainer locks to become dislocated when depressing the valve spring. Check to make sure the locks are in their proper location.

7. Install the vapor curtain, if equipped, and the cylinder head cover. Connect the negative battery cable.

V6 and V8 Engines

▶ See Figures 114, 115, 116 and 117

1. Remove the cylinder head and rocker assembly keeping all parts in original order.
2. Once the rocker assembly and pushrods are removed, use tool C–4129–A, or equivalent, to remove the valve lifters from their bores. Pull the tappet out of the bore with a twisting motion. Keep the tappets in order so they can be installed in their original bores.

To install:

3. Lubricate and install the lifters in their original locations. Make sure the oil feed hole in the side of the lifter body faces up (away from the crankshaft.
4. Install the rocker arm and shaft assembly. Next install the vent cover, distributor, start the engine.

V10 Engine

1. Disconnect the negative battery cable.
2. Remove the air cleaner and cylinder head cover.

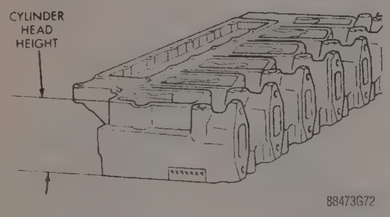


Fig. 112 Measure the cylinder head height between the indicated points—diesel engine cylinder head shown

Fig. 113 A dial gauge may be used to check valve stem-to-guide clearance

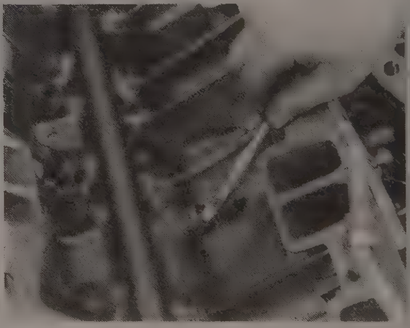


Fig. 114 A magnet is useful in removing lifters from their bores

Fig. 115 Stuck lifters must be freed using a slide hammer type lifter removal tool

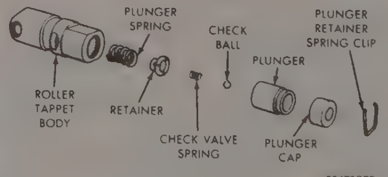


Fig. 116 Exploded view of a typical hydraulic tappet assembly assembly—V6 engine

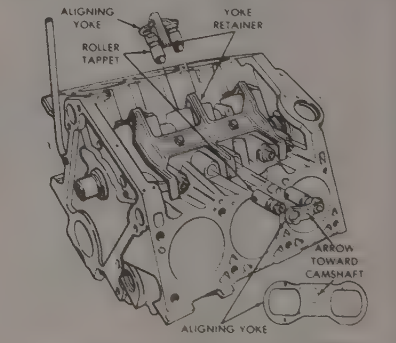


Fig. 117 Roller tappet aligning yoke and retainer—V6 engine

3. Remove the rocker arms assembly and pushrods. Label or organize the pushrods to enable installation in the original location.
4. Remove the upper and lower intake manifold.
5. If the end tappets are to be removed, remove the cylinder head.
6. Remove the yoke retainer spider and tappet aligning yokes.
7. Pull the tappets out of the bore with a twisting motion. Label or organize the tappets to enable installation in the original location.

➡Refer to the Overhaul procedure which follows.

8. Installation is the reverse of removal. Refer to the following important information.
    a. Install the tappets in their original positions. make sure the oil bleed hole (if equipped) faces FORWARD.
    b. Install the alignment yokes and retainer spider. Tighten the bolts to 16 ft. lbs. (22 Nm).
    c. Position the rocker arm assembly on the pedestal and align the pushrods. Install the bolts and tighten to 21 ft. lbs. (28 Nm).

OVERHAUL

➡Unless properly experienced and equipped, reaming the tappet bores should be left to a qualified shop.

Tappets may be overhauled by prying out the plunger retainer spring clip and disassembling the components. Keep all parts in order. Clean the varnish deposits from inside the tappet body above the plunger cap. Clean all parts in solvent which will remove varnish and carbon. If the plunger shows signs of scoring, wear or sticking and the valve is pitted, or if the valve seat on the end of the plunger indicates any condition which would prevent the valve from seating, ream the bore size and replace the tappet assembly with the next oversize.

Oil Pan

REMOVAL & INSTALLATION

2.5L Engine

➧ See Figure 118

1. Disconnect the negative battery cable. Remove the oil dipstick.
2. Disconnect the air pump relief valve upper hose. Raise the vehicle and support safely.
3. Remove the clutch housing to engine strut and clutch inspection cover.
4. Remove the lower radiator hose support bracket.
5. Slightly loosen the right motor mount through-bolt just enough to relieve the tension.
6. Using the proper equipment, support the weight of the engine. Loosen the left motor mount through-bolt enough to clear the bracket.
7. Raise the left side of the engine about 2 in. (51mm).
8. Remove the oil pan retaining screws and remove the oil pan and gasket.
9. Installation is the reverse of removal. Secure the pan retaining screws and tighten to 17 ft. lbs. (23 Nm). Tighten the motor mount through-bolts to 50 ft. lbs. (68 Nm).
10. Fill the engine with the proper amount of oil.

3.9L Engine

2-WHEEL DRIVE

➧ See Figure 119

1. Disconnect the negative battery cable. Remove the oil dipstick. Disengage the distributor cap and remove it away from the firewall.
2. Raise the vehicle and support safely.
3. Drain the engine oil.
4. Remove the exhaust crossover.
5. Loosen the motor mount bolts. Using the proper equipment, raise the engine. When the engine is high enough, install replacement bolts (similar in size to the motor mount bolts), in the engine mount attaching points on the frame brackets.
6. Lower the engine so the bottom of the motor mounts rest on the two replacement bolts. Remove the torque converter inspection cover, if equipped.
7. Remove the oil pan retaining screws and remove the oil pan and gaskets.
8. Installation is the reverse of removal. Secure the pan retaining screws to 17 ft. lbs. (23 Nm).
9. Fill the engine with the proper amount of oil and check for leaks.

4-WHEEL DRIVE

➧ See Figures 120, 121, 122 and 123

1. Disconnect the negative battery cable. Remove the oil dipstick.
2. Raise the vehicle and support safely.
3. Using the proper equipment, support the weight of the engine. Remove the front driving axle.
4. Remove the exhaust crossover and the lower transmission cover.
5. Remove the oil pan retaining screws and remove the oil pan and gaskets.
6. Installation is the reverse of removal. Secure the pan to the engine and tighten the retaining screws to 17 ft. lbs. (23 Nm).
7. Fill the engine with the proper amount of oil and check for leaks.

5.2L and 5.9L Engine

➧ See Figure 124

1. Disconnect the negative battery cable.
2. Remove the oil dipstick.
3. Raise and support the front end on jackstands.
4. Drain the oil.
5. Remove the exhaust cross-over pipe.
6. Remove the left engine-to-transmission strut.
7. Remove the bolts and lower the oil pan.
8. Thoroughly clean the gasket mating surfaces.
9. When installing the pan, always use new gaskets coated with sealer. Apply a drop of RTV silicone sealer where the cork and rubber gaskets meet. On the 5.9L engine, make sure the gasket notches are positioned as shown. Tighten

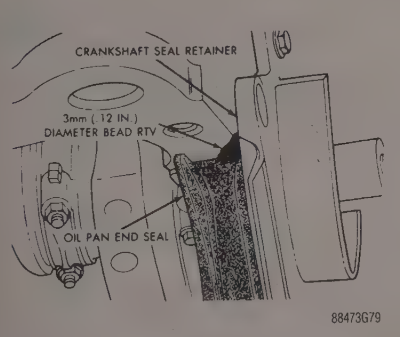


Fig. 118 Front and rear oil seals—2.5L engine

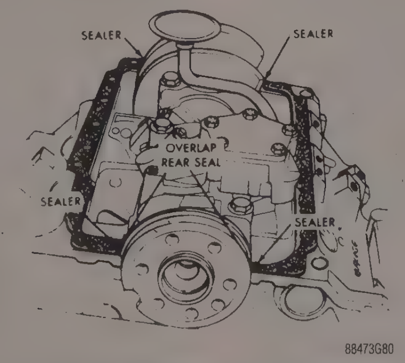


Fig. 119 Always install a new oil pan gasket on a clean surface—V6 engine shown

Fig. 120 Remove the crossmember to keep it from interfering with the oil pan removal

Fig. 121 Unbolt the pan using the correct socket and an extension of suitable length

Fig. 122 Maneuver the oil pan out and down from the engine

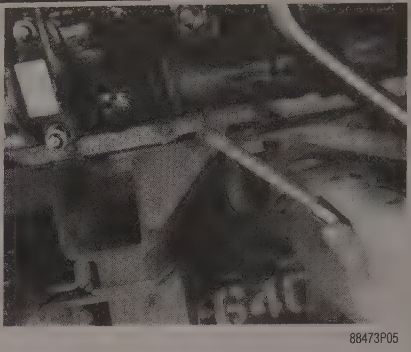


Fig. 123 Scrape all remaining gasket and old sealer away from the mating surfaces

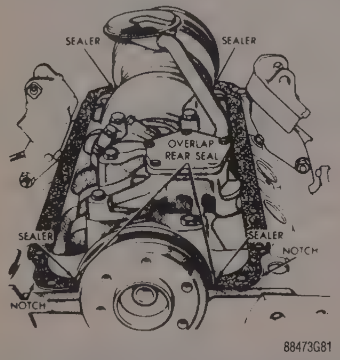


Fig. 124 Always install a new oil pan gasket on a clean surface—V8 engine shown

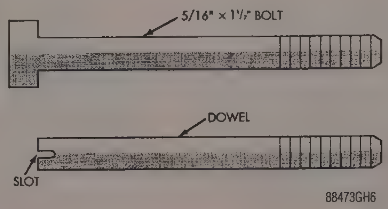


Fig. 125 Fabricate four alignment dowels by cutting the bolt heads off and slotting the tops—V10 engine

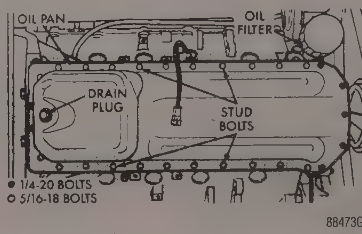


Fig. 126 Oil pan mounting bolt and stud location—V10 engine

the oil pan bolts to 15 ft. lbs. (20 Nm). Tighten the cross-over pipe to 24 ft. lbs. (32 Nm).

8.0L Engine

➧ See Figures 125 and 126

1. Disconnect the negative battery cable.
2. Remove the oil dipstick.
3. Raise and support the front end on jackstands.
4. Drain the oil.
5. Remove the left engine-to-transmission strut.
6. Remove the bolts and lower the oil pan. Remove the one piece gasket. The engine may have to be raised slightly on 2WD vehicles.
7. Remove the oil pickup tube assembly.

To install:

8. Thoroughly clean the gasket mating surfaces. If present, trim excess gasket sealant from the inside of the engine.
9. Clean the oil pan with solvent and dry thoroughly with a lint-free cloth.
10. Clean the oil screen and pipe. Inspect the condition of the screen.
11. Fabricate four alignment dowels from 5⁄16 x 1 ½ in. blots. Cut the heads off the bolts and cut a slot in the top to allow installation and removal with a screwdriver.
12. Install the dowels into the four corners with a screwdriver.
13. Apply a small quantity of Mopar®Silicon Rubber Adhesive Sealant, or equivalent at the split lines. These are between the cylinder block, timing chain cover and rear crankshaft seal.

➡After the sealant is applied, you have three minutes to install the gasket and oil pan.

14. Slide the one-piece gasket over the alignment dowels and position it on the block.
15. Position the oil pan over the gasket. The engine may have to be raised slightly on 2WD vehicles. Install the bolts and tighten the ½ in. blots to 96 inch lbs. (11 Nm) and the stud bolts to 144 inch lbs. (16 Nm). Tighten the 5⁄16 in. blots to 144 inch lbs. (16 Nm).
16. Remove the dowels and, in their place, install the four remaining 5⁄16 in. blots and tighten these bolts to 144 inch lbs. (16 Nm).
17. Install and tighten the drain plug to 25 ft. lbs. (34 Nm).
18. Install the engine-to-transmission strut.
19. Lower the vehicle. Connect the negative battery cable. Fill the crankcase with oil.

Oil Pump

REMOVAL & INSTALLATION

2.5L Engine

➧ See Figures 127 and 128

1. Crank the engine around so that the No. 1 piston is at TDC. Disconnect the negative battery cable.
2. Matchmark the rotor to the block and remove the distributor to confirm that the slot in the oil pump shaft is parallel to the centerline of the crankshaft. Matchmark the slot to the distributor bore, if desired.
3. Remove the dipstick. Raise the vehicle and support safely. Drain the engine oil and remove the pan.
4. Remove the oil pickup.
5. Remove the two mounting bolts and remove the oil pump from the engine.
6. Installation is the reverse of removal. Secure all components accordingly.
7. Prime the pump by pouring fresh oil into the pump intake and turning the driveshaft until oil comes out the pressure port. Repeat a few times until no air bubbles are present.
8. Apply sealer (Loctite®515, or equivalent) to the pump body to block

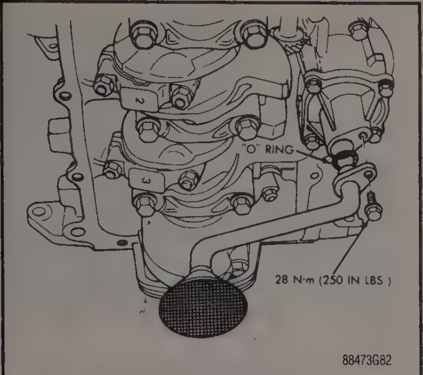


Fig. 127 Exploded view of the oil pickup tube mounting—2.5L engine

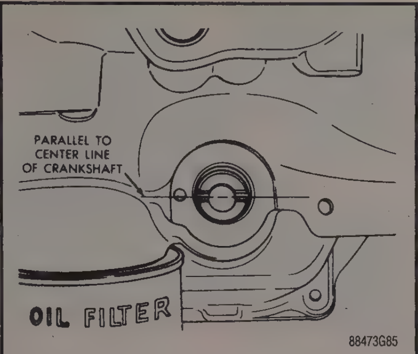


Fig. 128 Align the oil pump shaft as shown—2.5L engine

Fig. 129 Remove the screen, then unbolt the oil pump and remove it from the engine

machined surface interface. Lubricate the oil pump and distributor driveshaft.

9. Align the slot so it will be in the same position as when it was removed. If it is not, the distributor will not be timed correctly. Install the pump fully and rotate back and forth to ensure proper positioning between the pump mounting surface and the machined surface of the block.

10. Install the mounting bolts finger-tight and lower the vehicle to confirm proper slot positioning. If the slot is not properly positioned, raise the vehicle and move the gear as required. If the slot is correct, hold the pump firmly against the block and tighten the mounting bolts to 17 ft. lbs. (23 Nm).

11. Clean out the oil pickup or replace as required. Replace the oil pickup O-ring and install the pickup to the pump.

12. Fill the engine with the proper amount of oil. Connect the negative battery cable, check the timing and check the oil pressure.

3.9L, 5.2L and 5.9L Engines

➧ See Figure 129

1. Disconnect the negative battery cable.
2. Raise the vehicle and support safely. Drain the oil and remove the oil pan.
3. Remove the screen.
4. Unbolt the oil pump from the rear main bearing cap and remove it from the vehicle.

To install:

5. Prime the pump by pouring fresh oil into the pump intake and turning the driveshaft until oil comes out the pressure port. Repeat a few times until no air bubbles are present. Install the oil pump with a rotating motion to ensure proper pump driveshaft engagement.
6. Hold the pump flush against the main cap and finger-tighten the attaching bolts. Tighten the bolts to 30 ft. lbs. (40 Nm). Install the screen, and oil pan with a new gasket.
7. Connect the negative battery cable and check the oil pressure.

8.0L Engine

➧ See Figure 130

1. Remove the timing chain cover.
2. Remove the relief valve plug, gasket, spring and the valve. Discard the gasket.
3. Remove the oil pump cover.
4. Remove the pump rotors.

To install:

5. Install the oil pump and lubricate the pump rotors with petroleum jelly or Lubriplate®.
6. Install the timing chain cover.
7. Position the oil pump cover onto the timing chain cover and tighten the cover bolts to 125 inch lbs. (14 Nm).
8. After the cover is installed, make sure that the inner ring can still move freely and does not bind in any way.

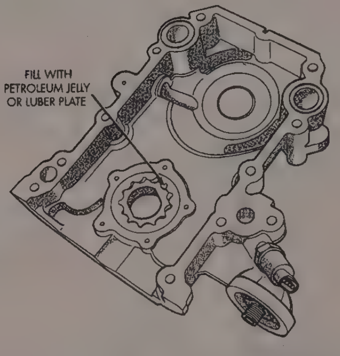


Fig. 130 Lubricate the rotors as a means of priming the oil pump so it is not dry on start-up—V10 engine

9. Install the timing chain cover. Squirt oil into the relief valve hole until oil runs out.
10. Using a new pressure relief valve gasket, install the relief valve plug, tightening it to 15 ft. lbs. (20 Nm).
11. Fill the oil filter with oil and install it on the engine.

Diesel Engine

1. Disconnect the negative battery cable.
2. Remove the drive belt, radiator and fan assembly.
3. Remove the oil fill tube and adaptor.
4. Remove the crankshaft pulley and front cover.
5. Remove the four pump mounting bolts and the pump from the block.

To install:

6. Prime the pump by pouring fresh oil into the pump intake and turning the driveshaft until oil comes out the pressure port. Repeat a few times until no air bubbles are present.
7. Align the idler gear pin with the locating bore in the block and install the pump.
8. Tighten the mounting bolts in the proper sequence to 44 inch lbs. (5 Nm), then repeat the torquing sequence to 18 ft. lbs. (24 Nm).

➡When the pump is correctly installed, the flange on the pump should not touch the block; the back plate on the pump seats against the bottom of the bore.

9. Measure the backlash of the idler to pump drive gears. The specification is 0.003-0.013 in. (0.08-0.33mm).
10. Measure the backlash of the idler to crankshaft gears. The specification is 0.003-0.013 in. (0.08-0.33mm).
11. The remainder of installation is the reverse of removal. Tighten each component to specifications.

Timing Belt Cover

REMOVAL & INSTALLATION

▶ See Figure 131

➡A timing belt is used only for the 2.5L engine.

1. Disconnect the negative battery cable.
2. Remove the nuts that attach the upper cover to the cylinder head cover.
3. Remove the bolt that attaches the upper cover to the lower cover.
4. Remove the upper cover.
5. Raise the vehicle and support safely. Remove the right side splash shield.
6. Remove the crankshaft pulley, water pump pulley and the belt(s).
7. Remove the lower cover attaching bolts.
8. Remove the lower cover.
9. Installation is the reverse of removal. Secure all components.

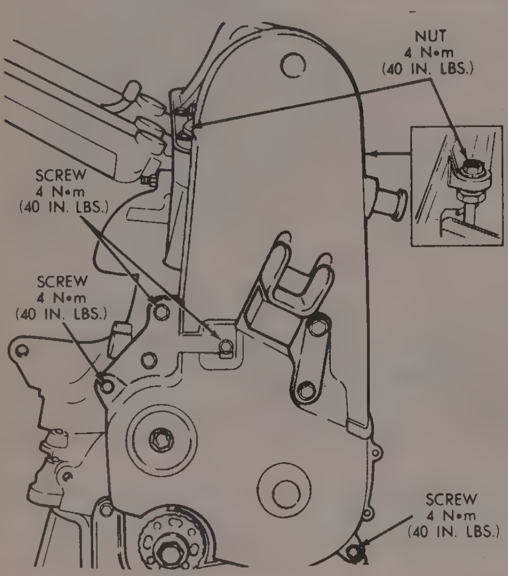


Fig. 131 Timing belt cover—2.5L engine

Timing Chain Cover

The 2.5L engine uses a timing belt. For information, please refer to the appropriate section in this manual. All other gasoline engines do have a timing chain, and are covered here.

REMOVAL & INSTALLATION

3.9L Engine

▶ See Figures 132, 133, 134, 135 and 136

1. Disconnect the negative battery cable.
2. Drain the cooling system.
3. If necessary, remove the radiator, fan and all related parts.
4. Remove the water pump.
5. Remove the crankshaft pulley.
6. Remove the vibration damper using the proper puller.
7. Disconnect the fuel lines from the fuel pump, if equipped.
8. Remove the two front bolts from the oil pan.
9. Unbolt the chain cover from the block and remove, using caution to avoid damaging the oil pan gasket.
10. Clean and dry the mating surfaces of the cover and block. Apply a thin bead of sealer to the oil pan gasket.
11. Install a new cover gasket and install the cover. Tighten the bolts to 30 ft. lbs. (41 Nm). The remainder of installation is the reverse of removal. Tighten each component to specifications.

5.2L and 5.9L Engines

▶ See Figures 137, 138 and 139

1. Remove the water pump.
2. Remove the power steering pump.
3. Remove the crankshaft pulley.
4. Remove the vibration damper with a puller. Remove the fuel lines and fuel pump, then loosen the oil pan bolts and remove the front bolt on each side.
5. Remove the timing chain cover and the crankshaft oil slinger.
6. Installation is the reverse of removal. Install the timing case cover with a new gasket. A ⅛ in.(3mm) bead of RTV sealer is recommended on the oil pan gasket. Tighten the cover bolts of 30 ft. lbs. (41 Nm). Retighten the engine oil pan to 17 ft. lbs. (23 Nm). Always use a centering tool to ensure that the seal will not be damaged and that it is properly aligned.
7. Lubricate the seal lip with lithium white grease and slide the damper back into position. Using tool C–3688, or equivalent, press the damper onto the shaft. Tighten the bolt to 135 ft. lbs. (183 Nm).

8.0L Engine

1. Disconnect the negative battery cable.
2. Drain the cooling system.
3. Remove the serpentine belt.
4. Remove the fan shroud and fan.
5. Unbolt the A/C compressor and set it on top of the engine.
6. Remove the alternator, air pump and bracket.
7. Remove the water pump.
8. Remove the crankshaft pulley/damper with a 3-prong puller.
9. Loosen the oil pan bolts and remove the front bolts that mount the pan to the timing chain cover.
10. Remove the timing chain cover and the gasket using extreme caution to avoid damaging the oil pan gasket.

Fig. 132 Unbolt and remove the crankshaft pulley

Fig. 133 Use a long-handled breaker bar to provide enough leverage to remove the crankshaft damper bolt

Fig. 134 Use a suitable puller tool to remove the crankshaft damper

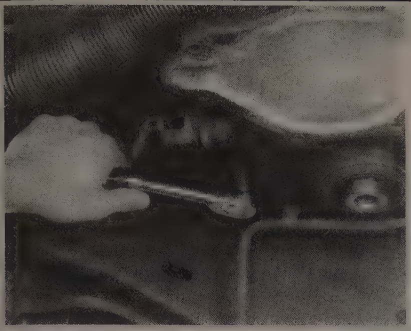


Fig. 135 When fully accessible, unbolt the timing chain cover

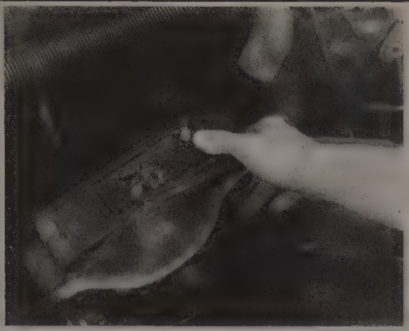


Fig. 136 Separate the timing chain cover to access the chain

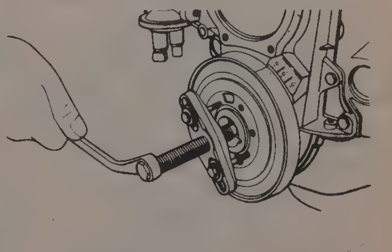


Fig. 137 Remove the vibration damper with a puller

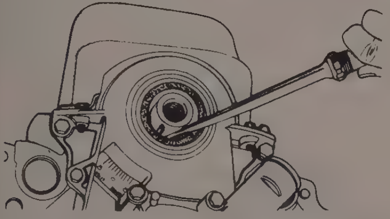


Fig. 138 Use a prytool to remove the front seal from the timing chain cover

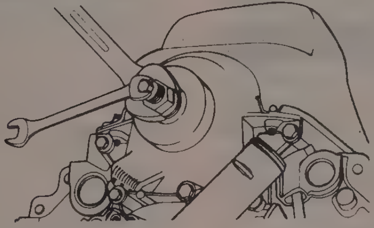


Fig. 139 Use a centering tool to install the front cover seal

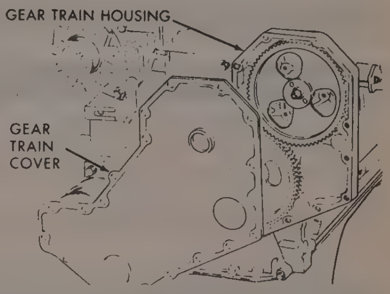


Fig. 140 Details of the timing gear cover—diesel engines only

11. Inspect the cover surface. Remove any burrs or high spots.

To install:

12. Clean all gasket surfaces thoroughly.
13. Install a new seal in the case.
14. Install the timing case cover with a new gasket. A ⅛ in.(3mm) bead of RTV sealer is recommended on the oil pan gasket. Tighten the cover bolts to 35 ft. lbs. (47 Nm). Retighten the engine oil pan to 215 inch lbs. (24 Nm). Always use a centering tool to ensure that the seal will not be damaged and that it is properly aligned.
15. Lubricate the seal lip with lithium white grease and slide the damper back into position. Using tool C–3688, or equivalent, press the pulley/vibration damper onto the shaft. Tighten the bolt to 135 ft. lbs. (183 Nm).
16. Install all remaining components in the reverse order of removal. Tighten each component to specifications.
17. Road test the vehicle to check for leaks.

Timing Gear Cover

REMOVAL & INSTALLATION

➧ See Figure 140

This procedure pertains only to diesel engines. These are the only engines covered in this manual which operate by timing gears.

1. Disconnect the negative battery cable.
2. Remove the fan drive assembly and belt.
3. Remove the belt tensioner.
4. Remove the oil fill tube and adaptor.
5. Remove the crankshaft pulley.
6. Remove all bolts that attach the cover to the gear housing.
7. Gently pry the gear cover away from the housing and remove from the engine.
8. Installation is the reverse of removal. Secure the cover bolts to 18 ft. lbs. (24 Nm).
9. Tighten the crankshaft pulley bolts to 92 ft. lbs. (125 Nm).

Front Cover Oil Seal

REMOVAL & INSTALLATION

3.9L Engine

1. Disconnect the negative battery cable.
2. Remove the belt(s) from the crankshaft pulley.
3. Remove the fan and shroud from the vehicle.
4. Remove the crankshaft pulley.
5. Remove the vibration damper using the proper puller.
6. Using a suitable tool behind the lips of the oil seal, pry outward. Take care not to damage the crankshaft seal surface of the cover.

To install:

7. Install the new seal by installing the threaded shaft part of special tool C–4251, or equivalent, into the threads of the crankshaft.
8. Place the seal into the opening with the spring toward the engine. Place the installing adapter C–4251-3, or equivalent, with the thrust bearing and nut on the shaft. Tighten the nut until the tool is flush with the timing chain cover. Remove the tool.
9. The remainder of installation is the reverse of removal.
10. Start the engine and check for leaks.

5.2L and 5.9L Engines

➡A seal remover and installer tool is required to prevent seal damage.

1. Using a seal puller, separate the seal from the retainer.
2. Pull the seal from the case.

To install:

3. Place the seal face down in the case with the seal lips downward.
4. Seat the seal tightly against the cover face. There should be a maximum clearance of 0.0014 in (0.035mm) between the seal and the cover. Be careful not to overcompress the seal.

Diesel Engine

1. Disconnect the negative battery cable.
2. Remove the drive belt.
3. Remove the crankshaft pulley.
4. Drill two 1/8 in. (3mm) holes into the seal face, 180°apart. Drill two 1/8 in. (3mm) holes into the seal face, 180°apart.
5. Using a slide hammer with a No. 10 sheet metal screw, pull the seal out alternating from side-to-side until the seal is out.

To install:

6. Thoroughly clean and dry the end of the crankshaft.
7. Apply a bead of Loctite®277 to the outside diameter of the seal.
8. Install the pilot from the seal kit onto the crankshaft.
9. Install the seal onto the pilot and start it into the front cover seal bore. Remove the pilot.
10. Use the alignment/installation tool and a plastic hammer to fully install the seal.
11. Install the crankshaft pulley, but do not tighten the bolts at this point.
12. Install the drive belt, then tighten the crankshaft pulley bolts to 92 ft. lbs. (125 Nm).
13. Connect the negative battery cable and check for leaks.

Timing Belt

ADJUSTMENT

1. Disconnect the negative battery.
2. Raise the vehicle and support safely. Remove the right front inner splash shield.
3. Remove the tensioner cover.
4. Place the special tensioning tool C–4703, or equivalent, on the hex of the tensioner so the weight is at about the 10 o'clock position and loosen the bolt.
5. The tensioner should drop down to the 9 o'clock position. Reposition the tool as required in order to have it end up at the 9 o'clock position (parallel to the ground, hanging to the left) plus or minus 15°.
6. Hold the tool in position and tighten the bolt. Do not pull the tool past the 9 o'clock position; this will make the belt too tight and will cause it to howl or possibly break.
7. Install the cover and the splash shield.

REMOVAL & INSTALLATION

➧ See Figures 141 and 142

➡If possible, position the engine so that the No. 1 piston is at TDC.

1. Disconnect the negative battery cable.
2. Remove the timing belt covers.
3. Remove the timing belt tensioner and allow the belt to hang free.
4. Remove the air conditioning compressor belt idler pulley, if equipped and remove the mounting stud. Unbolt the compressor/alternator bracket and position it to the side.
5. Remove the timing belt from the vehicle.

To install:

6. Turn the crankshaft sprocket and intermediate shaft sprocket until the marks are in line. Use a straightedge shaft sprocket until the marks are in line. Use a straightedge from bolt to bolt to confirm alignment.
7. Turn the camshaft until the small hole in the sprocket is at the top and rows on the hub are in line with the camshaft cap to cylinder head mounting lines. Use a mirror to see the alignment so it is viewed straight on and not at an angle from above. Install the belt, built let it hang free at this point.
8. Install the air conditioning compressor/alternator bracket, idler pulley and motor mount. Remove the floor jack. Raise the vehicle and support safely. Have the tensioner at an arm's reach because the timing belt will have to be held in position with one hand.
9. To properly install the timing belt, reach up and engage it with the camshaft sprocket. Turn the intermediate shaft counterclockwise slightly, then engage the belt with the intermediate shaft sprocket. Hold the belt against the intermediate shaft sprocket and turn clockwise to take up all tension; if the timing marks are out of alignment, repeat until alignment is correct.

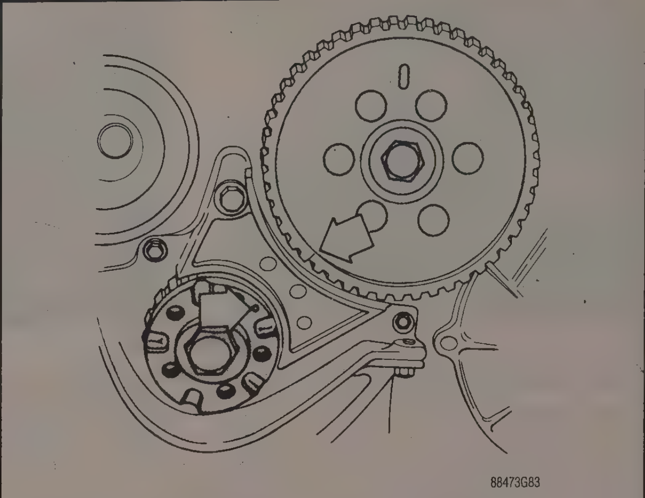


Fig. 141 Align the crankshaft and intermediate shaft timing mark as indicated—2.5L engine

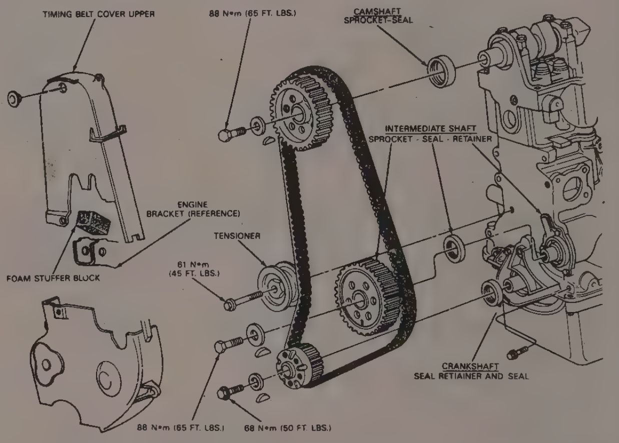


Fig. 142 Exploded view of the timing belt, sprockets, cover and seals—2.5L engine

10. Using a 13mm wrench, turn the crankshaft sprocket counterclockwise slightly and wrap the belt around it. Turn the sprocket clockwise so there is no slack in the belt between sprockets, if the timing marks are out of alignment, repeat until alignment is correct.

➡If the timing marks are in line but slack exists in the belt between either the camshaft and intermediate shaft sprockets or the intermediate and crankshaft sprockets, the timing will be incorrect when the belt is tensioned. All slack must be only between the crankshaft and camshaft sprockets.

11. Install the tensioner and install the mounting bolt loosely. Place special tensioning tool C–4703, or equivalent, on the hex of the tensioner so the weight is at about the 9 o'clock position (parallel to the ground, hanging to the left) plus or minus 15°.
12. Hold the tool in position and tighten the bolt to 45 ft. lbs. (61 Nm). Do not pull the tool past the 9 o'clock position; this will make the belt too tight and will cause it to howl or possibly break.
13. Lower the vehicle and recheck the camshaft sprocket positioning. If it is correct install the timing belt covers and all related parts.
14. Connect the negative battery cable and road test the vehicle.

Timing Chain

REMOVAL & INSTALLATION

3.9L Engine

➧ See Figures 143, 144, 145, 146 and 147

1. If possible, crank the engine around so that the No. 1 cylinder is at TDC on the compression stroke. Remove the distributor cap to confirm and line the timing mark on the damper pulley with "0" on the timing scale. This will aid in aligning timing marks when installing the timing gears. Disconnect the negative battery cable.
2. Drain the cooling system.
3. Remove the radiator, fan and all related parts. Remove the water pump.
4. Remove the crankshaft pulley.
5. Remove the vibration damper using the proper puller.
6. Unbolt the chain cover from the block and remove, using caution to avoid damaging the oil pan gasket. Remove the fuel pump from the cover, if equipped.
7. Remove the camshaft gear retaining bolt and cup washer. Remove the timing chain and gears. If necessary, remove the chain and upper gear, then use a gear puller to remove the lower gears.

To install:

8. Place both camshaft and crankshaft gears on the bench with the timing marks on the exact imaginary center line through both gear bores as they are installed on the engine.
9. Place the timing chain around both sprockets.
10. Turn the crankshaft and camshaft so the keys line up with the keyways in the gears when the timing marks are in proper position.
11. The remainder of installation is the reverse of removal. Tighten each component to specifications.
12. Fill the cooling system.
13. Connect the negative battery cable, set all adjustment to specifications and check for leaks.

5.2L and 5.9L Engines

➧ See Figures 147 and 148

1. Remove the front cover.
2. Remove the camshaft sprocket lockbolt, securing cup washer, and fuel pump eccentric. Remove the timing chain with both sprockets.

To install:

3. To begin the installation procedure, place the camshaft and crankshaft sprockets on a flat surface with the timing indicators on an imaginary centerline through both sprocket boxes. Place the timing chain around both sprockets. Be sure that the timing marks are in alignment.

✲✲ WARNING

When installing the timing chain, have an assistant support the camshaft with a suitable tool to prevent it from contacting the plug in the rear of the engine block. Remove the distributor and the oil pump/distributor drive gear. Position the suitable tool against the rear side of the cam gear and be careful not to damage the cam lobes.

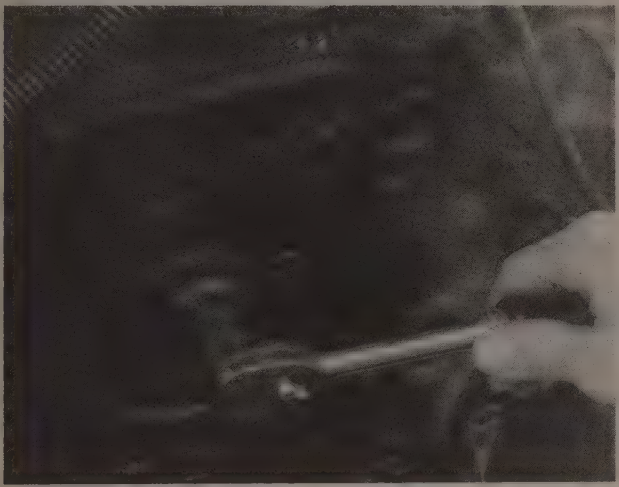

88473P22

Fig. 143 Unbolt the upper timing chain gear

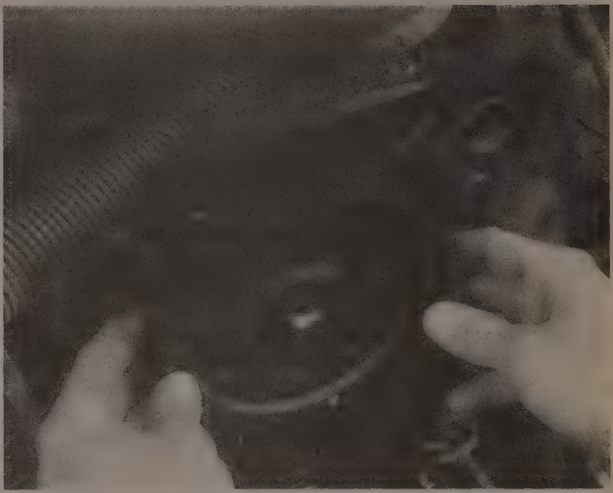

88473P23

Fig. 144 Remove the timing chain and gears

88473P24

Fig. 145 Ordinarily, you should remove the two gears and chain as a set, unless the lower gear is press-fitted

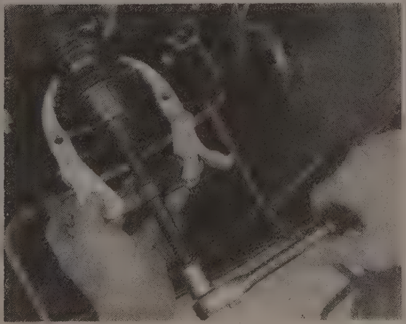
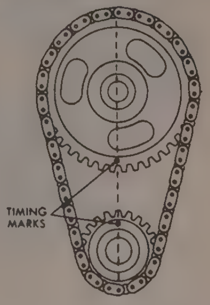

88473P25

Fig. 146 Use a puller to remove the lower timing chain gear, if necessary



88473GA2

Fig. 147 Make sure the timing alignment marks are in line as shown—V6 and V8 engines

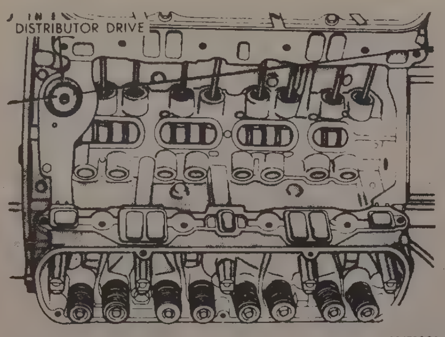


Fig. 148 Position the distributor drive gear correctly—V8 engine shown

4. Turn the crankshaft and camshaft to align them with the keyway location in the crankshaft sprocket and the keyway or dowel hole in the camshaft sprocket.
5. Lift the sprockets and timing chain while keeping the sprockets tight against the chain in the correct position. Slide both sprockets evenly onto their respective shafts.
6. Use a straightedge to measure the alignment of the sprocket timing marks. They must be perfectly aligned.
7. Install the fuel pump eccentric, cup washer, and camshaft sprocket lockbolt and tighten to 35 ft. lbs. (47 Nm). If camshaft end-play exceeds 0.010 in. (0.25mm), install a new thrust plate. It should be 0.002-0.006 in. (0.05-0.15mm) with the new plate.

8.0L Engine

➧ See Figures 149 and 150

1. Align the camshaft and crankshaft centerline. Remove the camshaft sprocket attaching bolt and remove the timing chain and camshaft sprockets.
2. Use puller No. 6444 and jaws No. 6920, or equivalent, to pull the crankshaft sprocket.

To install:

3. Align the key in the crankshaft sprocket with the sprocket. Press on the crankshaft sprocket using tools No. C–3688, C–3718 and MB–990799, or their equivalents. Seat the sprocket against the crankshaft shoulder.
4. Turn the crankshaft to line up the timing mark with the crankshaft and camshaft centerline.
5. Put the timing chain on the camshaft sprocket.
6. Align the timing marks and install the chain and camshaft sprocket onto the crankshaft sprocket. Check to see that the timing marks are on the centerline of the crankshaft and camshaft centerline.
7. Install the camshaft bolt. Tighten the bolt to 45 ft. lbs. (61 Nm).

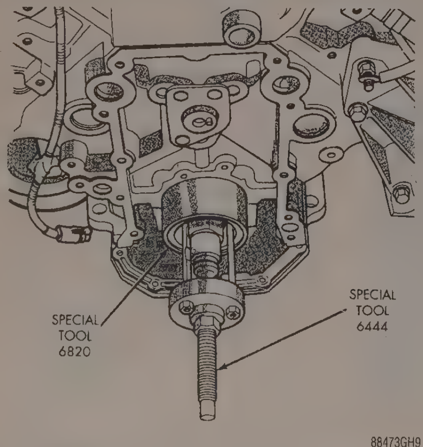


Fig. 149 Use the special puller tool to remove the crankshaft sprocket—V10 engine

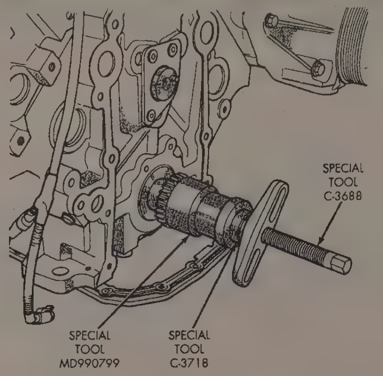


Fig. 150 Install the crankshaft sprocket using the three special tools shown—V10 engine

8. Check the camshaft end-play. If a new thrust plate was installed, the clearance should be 0.002–0.006 in. (0.051–0.152mm). If the used thrust plate is installed, the end-play clearance may be up to 0.010 in. (0.254mm).
9. If not within these limits, install a new thrust plate.

CHECKING TIMING CHAIN SLACK

➡This procedure applies to all models that use a timing chain.

1. Position a scale (ruler of straightedge) next to the timing chain to detect any movement in the chain.
2. Place a torque wrench and socket on the camshaft sprocket attaching bolt. If the cylinder heads are installed on the engine, apply 30 ft. lbs. (41 Nm). If the heads are removed, apply 15 ft. lbs. (20 Nm) of force to the bolt and rotate the bolt in the direction of crankshaft rotation in order to remove all slack from the chain.
3. While applying torque to the camshaft sprocket bolt, the crankshaft should not be allowed to rotate. It may be necessary to block the crankshaft to prevent its rotation.
4. Position the scale over the edge of a timing chain link and apply an equal amount of torque in the opposite direction. If the movement of the chain exceeds ⅛ in.(3mm), replace the chain.

Timing Gears

REMOVAL & INSTALLATION

➧ See Figure 151

This procedure pertains only to the diesel engine.

1. Remove the timing gear cover to gain access to the timing gears.
2. Simply unbolt the gears and slide them off their respective shafts. See the illustration for correct timing gear alignment.

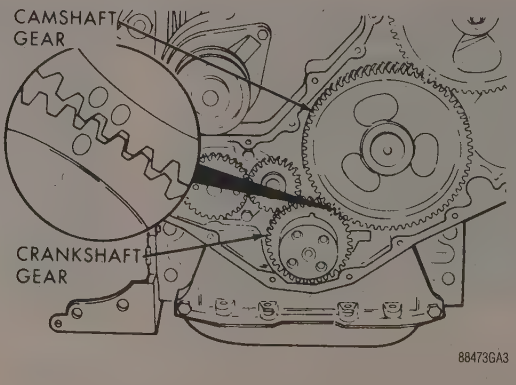


Fig. 151 Timing gear alignment—diesel engine

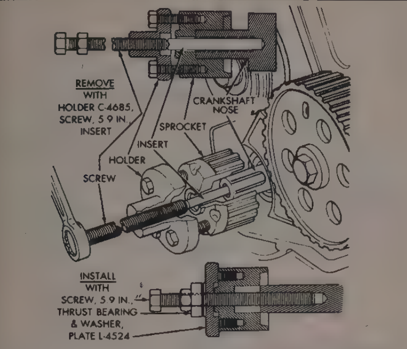

REMOVE
WITH
HOLDER C-4685,
SCREW, 5.9 IN.,
INSERT
CRANKSHAFT
NOSE
SPROCKET
INSERT
HOLDER
SCREW
INSTALL
WITH
SCREW, 5.9 IN.,
THRUST BEARING
& WASHER,
PLATE L-4524
88473GA6

Fig. 152 Use a special tool as shown to remove the crankshaft sprocket

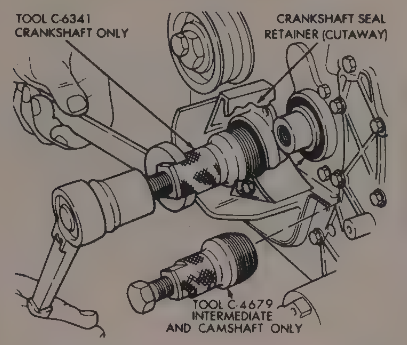

TOOL C-6341
CRANKSHAFT ONLY
CRANKSHAFT SEAL
RETAINER (CUTAWAY)
TOOL C-4679
INTERMEDIATE
AND CAMSHAFT ONLY
88473GA7

Fig. 153 Use a special tool as shown to extract the intermediate shaft

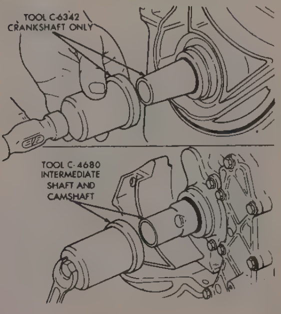

TOOL C-6342
CRANKSHAFT ONLY
TOOL C-4680
INTERMEDIATE
SHAFT AND
CAMSHAFT
88473GA8

Fig. 154 Install the crankshaft and intermediate shaft oil seal as shown—2.5L engine

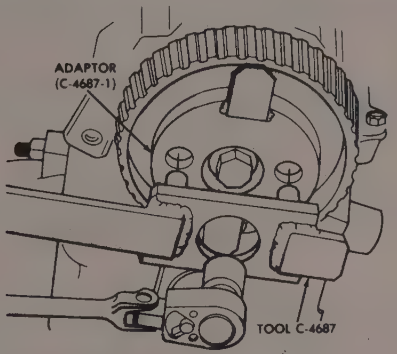

ADAPTOR
(C-4687-1)
TOOL C-4687
88473GA9

Fig. 155 Remove the camshaft sprocket with the special tool shown

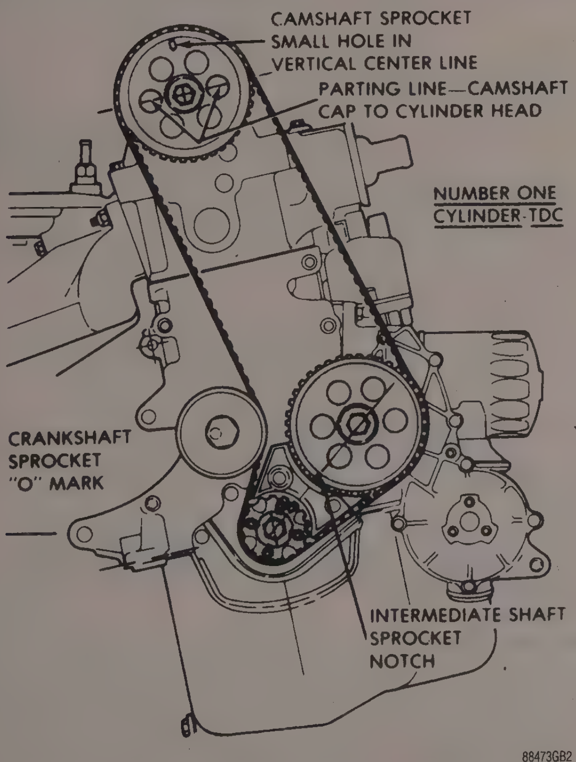

CAMSHAFT SPROCKET
SMALL HOLE IN
VERTICAL CENTER LINE
PARTING LINE—CAMSHAFT
CAP TO CYLINDER HEAD
NUMBER ONE
CYLINDER-TDC
CRANKSHAFT
SPROCKET
"O" MARK
INTERMEDIATE SHAFT
SPROCKET
NOTCH
88473GB2

Fig. 156 Use this reference as a guide to correctly install the timing belt and sprockets

Timing Sprockets

REMOVAL & INSTALLATION

See Figures 152, 153, 154, 155 and 156

This procedure pertains to the 2.5L engine only.

1. Disconnect the negative battery cable.
2. Remove the timing belt.
3. Remove the crankshaft sprocket bolt.
4. Using the puller tool C–4685, or equivalent, and the button from tool L-4524, or equivalent, remove the crankshaft sprocket.
5. Using tool C–4687 or equivalent, hold the camshaft and/or intermediate sprocket, while removing the centerbolt and sprocket(s).
6. The installation is the reverse of the removal procedure. Tighten the camshaft and intermediate sprocket bolt to 65 ft. lbs. (88 Nm) and the crankshaft sprocket bolt to 50 ft. lbs. (68 Nm).

Intermediate Shaft

REMOVAL & INSTALLATION

2.5L Engine

See Figures 153, 154, 156 and 157

1. Disconnect the negative battery cable.
2. Crank the engine around until the No. 1 piston is at TDC. Remove the timing belt covers to confirm that all timing marks are lined up.
3. Remove the fuel pump, if equipped. Remove the distributor. Looking down at the oil pump, the slot in the shaft must be paralleled with the center line of the crankshaft. Remove the oil pump.
4. Remove the timing belt and the intermediate shaft sprocket.

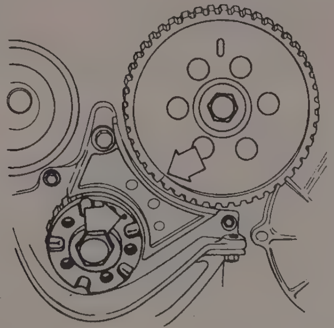


Fig. 157 Align the crankshaft and intermediate shaft timing marks as shown—2.5L engine

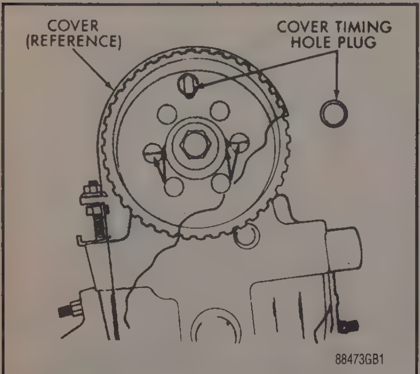


Fig. 158 Be careful to properly align the camshaft timing marks

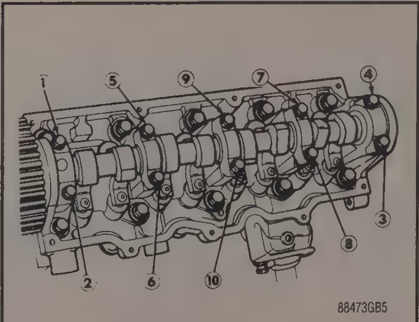


Fig. 159 Camshaft cap bolt tightening sequence—2.5L engine

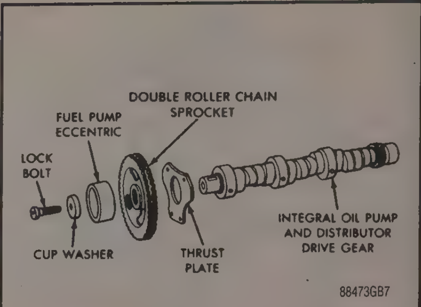

DOUBLE ROLLER CHAIN SPROCKET
FUEL PUMP ECCENTRIC
LOCK BOLT
CUP WASHER
THRUST PLATE
INTEGRAL OIL PUMP AND DISTRIBUTOR DRIVE GEAR
88473GB7

Fig. 160 Exploded view of the camshaft and dual sprocket assembly—V6 engine

5. Remove the shaft retainer bolts and remove the retainer from the block.
6. Remove the intermediate shaft from the engine.
7. If necessary, remove the front bushing using tool C–4697–2 and the rear bushing using tool C–4686–2, or their equivalents.

To install:

8. Install the front bushing using tool C4697–1 until the tool is flush with the block. Install the rear bushing using tool C–4686–1 until the tool is flush with the block.
9. Lubricate the distributor drive gear and install the intermediate shaft.
10. Replace the seal in the retainer and apply silicone sealer to the mating surface of the retainer. Install the retainer to the block and tighten the bolts to 10 ft. lbs. (12 Nm).
11. Install the intermediate shaft sprocket and the timing belt.
12. With the timing belt properly installed, install the oil pump so the slot is parallel to the center line of the crankshaft.
13. Install the distributor so the rotor is aligned with the No. 1 spark plug wire tower on the cap.
14. Install the fuel pump, if equipped.
15. Connect the negative battery cable and road test the vehicle.

Camshaft

REMOVAL & INSTALLATION

2.5L Engine

➧ See Figures 155, 158 and 159

1. Disconnect the negative battery cable. Relieve the fuel pressure, if equipped with fuel injection.
2. Turn the crankshaft so the No. 1 piston is at the TDC of the compression stroke. Remove the upper timing belt cover. Remove the air pump pulley, if equipped.
3. Remove the camshaft sprocket bolt and the sprocket and suspend tightly so the belt does not lose tension. If it does, the belt timing will have to be reset.
4. Remove the cylinder head cover.
5. If the rocker arms are being reused, mark them for installation identification and loosen the camshaft bearing bolts evenly and gradually.
6. Using a soft mallet, tap the rear of the camshaft a few times to break the bearing caps loose.
7. Remove the bolts, bearing caps and the camshaft with seals.

➡Before replacing the camshaft, identify factory installed oversized components. To do so, look for the tops of the bearing caps painted green and O/SJ stamped rearward of the oil gallery plug on the rear of the head. In addition, the barrel of the camshaft is painted green and O/SJ is stamped onto the rear end of the camshaft. Installing standard sized parts in a head equipped with oversized parts —or vice versa — will cause severe engine damage. Also, take note of the color of the paint stripe on the rear camshaft seal. These stripes differentiate seal sizes. If a seal with a different color stripe is installed, a severe leak will develop if the seal is too small, or the cap will not be able to be fully installed if the seal is too big.

8. Check the oil passages for blockages and the parts for wear and damage and replace parts, as required. Clean the gasket mounting surfaces.

To install:

9. Transfer the sprocket key to the new camshaft. New rocker arms and a new camshaft sprocket bolt are normally included with the camshaft package. Install the rocker arms, lubricate the camshaft and install with end seals installed.
10. Place the bearing caps with No. 1 at the timing belt end and No. 5 at the transaxle end. The camshaft bearing caps are numbered and have arrows facing forward. Tighten the camshaft bearing bolts evenly and gradually to 18 ft. lbs. (24 Nm).

➡Apply RTV silicone gasket material to the No. 1 and 5 bearing caps. Install the bearing caps before the seals are installed.

11. Mount a dial indicator to the front of the engine and check the camshaft end-play. Play should not exceed 0.006 in. (0.15mm).
12. Install the camshaft sprocket and the new bolt. Install the air pump pulley, if equipped.
13. Install the cylinder head cover with a new gasket.
14. Connect the negative battery cable and check for leaks.

3.9L Engine

➧ See Figures 160, 161 and 162

1. If possible, crank the engine around so that the No. 1 cylinder is at TDC on the compression stroke. Remove the distributor cap to confirm and line the timing mark on the damper pulley with "O" on the timing scale. This will aid in aligning timing marks when installing the timing gears.
2. If the vehicle is equipped with fuel injection, relieve the fuel pressure. Disconnect the negative battery cable.
3. Drain the cooling system.
4. Remove the cylinder head cover(s).
5. Remove the rocker shaft assemblies. Identify and remove the pushrods.
6. Remove the intake manifold. Identify and remove all lifters.
7. Remove the distributor.
8. Lift out the oil pump and distributor driveshaft.
9. Remove the radiator, fan and all related parts.
10. Remove the fuel pump, if equipped. Remove the timing chain cover, timing chain and gears.
11. Note the location of the oil tab and remove the camshaft thrust plate.
12. Install suitable long bolt into the front of the camshaft to facilitate removal. Remove the camshaft, being careful not to damage any of the cam bearings with the cam lobes.

To install:

13. Install the camshaft to within 2 in. (50mm) of its final installation position.
14. Install the camshaft blocking tool C–3509, or equivalent, and bolt it in place with the distributor hold-down bolt. This will prevent the camshaft from being pushed in too far and knocking out the welch plug at the rear of the block. This tool should remain in place until the timing chain installation has been completed.
15. Install the camshaft thrust plate and chain oil tab. Make sure the tang of the oil tab enters the hole in the thrust plate at the lower right. Tighten the bolts

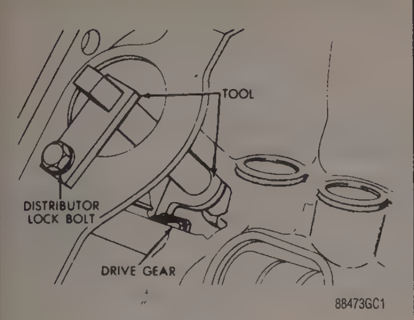


Fig. 161 Use the special holding tool to keep the camshaft in position during installation—V6 and V8 engines

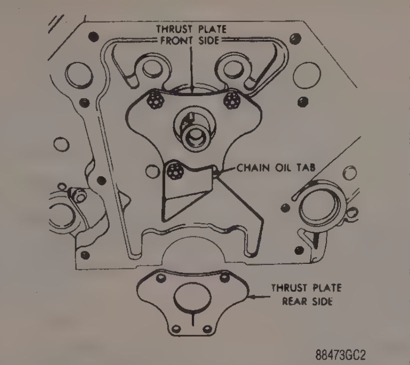


Fig. 162 Install the timing chain oil tab as shown—V6 and V8 engines

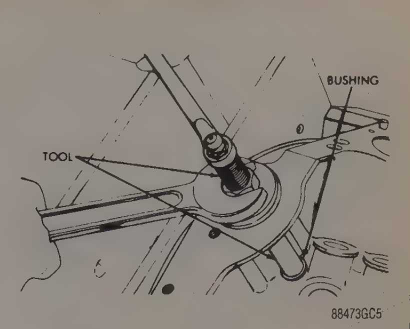


Fig. 163 Burnish the bushing using the special tool as shown—V8 engines

to 18 ft. lbs. (24 Nm). Make sure the top edge of the toil tab is flat against the thrust plate or it will not feed oil to the chain.

16. Place both camshaft and crankshaft gears on the bench with the timing marks on the exact imaginary center link through both gear bores as they are installed on the engine. Place the timing chain around both sprockets.
17. Turn the crankshaft and camshaft so the keys line up with the keyways in the gears when the timing marks are in proper position.
18. Slide both gears over their respective shafts and use a straightedge to check timing mark alignment.
19. Install the fuel pump eccentric and cup washer, if equipped. Tighten the camshaft gear retaining bolt to 35 ft. lbs. (47 Nm).
20. Remove the camshaft blocking tool, if it was installed.
21. Measure camshaft end-play, if applicable. Replace the thrust plate if not within specifications.
22. Coat the oil pump and distributor driveshaft with oil. Install the shaft so that when the gear spirals into place and drops into the oil pump, the slot in the top of the gear is pointing directly to the left front intake manifold bolt hole.
23. If the camshaft was not replaced, lubricate and install the lifters in their original locations. If the camshaft was replaced, new lifters must be used. Install all remaining components in the reverse order of removal.
24. Fill the radiator with coolant.
25. Connect the negative battery cable, set all adjustments to specifications and check for leaks.

5.2L and 5.9L Engines

➧ See Figures 161, 162 and 163

1. Drain the cooling system and disconnect the negative battery cable.
2. Remove the intake manifold, cylinder head covers, rocker arm assemblies, pushrods, and valve tappets, keeping them in order to insure the installation in their original locations.
3. Remove the timing gear cover, the camshaft and the crankshaft sprockets, and the timing chain.
4. Remove the distributor and lift out the oil pump and distributor driveshaft.
5. If the distributor driveshaft bushing is excessively worn, it must be pulled with a threaded inserting puller tool as follows:
    a. Insert distributor driveshaft bushing puller tool C–3052, or equivalent, into the old bushing and thread it in until the fit is tight.
    b. Turn the puller nut while holding the screw with a wrench and pull the bushing out.
6. Remove the camshaft thrust plate.
7. Install a long bolt into the front of the camshaft and remove the camshaft, being careful not to damage the cam bearings with the cam lobes.

To install:

➡Prior to installation, lubricate the camshaft lobes and bearings journals. It is recommended that one pint of Mopar®Crankcase Conditioner be added to the initial crankcase oil fill. Insert the camshaft into the engine block within 2 in. (51mm) of its final position in the block. Have an assistant support the camshaft with a suitable tool to prevent the camshaft from contacting the plug in the rear of the engine block. Position the suitable tool against the rear side of the cam gear and be careful not to damage the cam lobes.

8. Install the camshaft thrust plate. If camshaft end-play exceeds 0.010 in. (0.25mm), install a new thrust plate. It should be 0.002–0.006 in (0.15mm) with the new plate.
9. Install the timing chain and sprockets, timing gear cover, and pulley.
10. Install the tappets, pushrods, rocker arms, and cylinder head covers. Install fuel pump, if removed.
11. If the distributor driveshaft bushing was removed, install a new one as follows:
    a. Slide the new bushing over the burnishing end of the special Driver/Burnisher tool No. C–3053, or equivalent, and insert the tool and bushing into the bore.
    b. Use a hammer to drive the bushing and tool into position.
    c. As the burnisher tool is pulled through the bushing, the bushing will be expanded tight in the block and burnished to the correct size.

✲✲ WARNING

Bushing installation must be performed as described. Do NOT attempt to ream the bushing. Failure to follow these instructions could result in distributor shaft seizure!

12. The remainder of installation is the reverse of removal. Tighten each component to specifications.
13. After starting the engine, adjust the ignition timing.

8.0L Engine

1. Drain the cooling system and disconnect the negative battery cable.
2. Remove the cylinder head covers, rocker arm assemblies, pushrods, and valve tappets, keeping them in order to insure the installation in their original locations.

➡Keep all tappets in order for reassembly in the exact same position as when removed. The four corner tappets cannot be removed without removing the cylinder heads and gaskets. However they can be lifted and retained for camshaft removal.

3. Remove the upper and lower intake manifold.
4. Remove the timing chain cover, timing chain, the timing chain thrust plate and the timing chain.
5. Remove the distributor and lift out the oil pump and distributor driveshaft.
6. Install a long bolt into the front of the camshaft and remove the camshaft, being careful not to damage the cam bearings with the cam lobes.

To install:

➡Prior to installation, lubricate the camshaft lobes and bearings journals. It is recommended that one pint of Mopar®Crankcase Conditioner be added to the initial crankcase oil fill. Insert the camshaft into the engine block within 2 in. (51mm) of its final position in the block. Have an assistant support the camshaft with a suitable tool to prevent the camshaft from contacting the plug in the rear of the engine block. Position the suitable tool against the rear side of the cam gear and be careful not to damage the cam lobes.

7. Install the camshaft thrust plate. If camshaft end-play exceeds 0.010 in. (0.254mm), install a new thrust plate. Normal tolerance for a new plate should be 0.051–0.152 in. (0.002–0.006mm).

8. Line up the key with the keyway in the sprocket and press on the crankshaft timing sprocket using special tool Nos. C–3688, C–3718 and MB990799, or equivalent, to seat the sprocket against the crankshaft shoulder.

9. Align the timing mark on the crankshaft sprocket with the centerline of the crankshaft and camshaft.

10. Put the timing chain on the camshaft sprocket.

11. Take the chain and camshaft sprockets and align the mark with the centerline of the crankshaft and camshaft install camshaft sprocket and chain to camshaft.

12. Install the camshaft bolt. Tighten the bolt to 55 ft. lbs. (75 Nm). The remainder of installation is the reverse of removal. Tighten each component to specifications.

➡The cylinder head cover gasket can be reused. For the left side, the number tab is at the front of the engine with the number up. For the right side the number tab is at the rear of the engine.

WARNING

The cylinder head cover fasteners have a special plating and should not be substituted for another fastener.

13. Position the cylinder head cover onto the gasket. Install the stud bolts and hex head bolts in the proper positions. Tighten the stud bolts and the bolts to 144 inch lbs. (16 Nm).

14. Install the intake manifolds.

15. Refill the cooling and reconnect the negative battery cable.

Diesel Engine

➧ See Figures 164, 165 and 166

1. Disconnect the negative battery cable.
2. Remove the cylinder head covers.
3. Remove the rocker pedestal and arm assemblies.
4. Remove the pushrods.
5. Remove the drive belt.
6. Drain the cooling system. Remove the fan assembly, radiator and all related parts.
7. Remove the crankshaft pulley.
8. Remove the front gear cover.
9. Remove the fuel pump.
10. Insert the special dowels into the pushrod holes and onto the top of each lifter. When properly installed, the dowels can be used to hold the tappets up securely. Wrap rubber bands around the top of the dowels to prevent them from dropping down.
11. Rotate the crankshaft to align the crankshaft to camshaft timing marks.
12. Remove the bolts from the thrust plate.
13. Remove the camshaft and thrust plate.
14. Press the gear from the camshaft and remove the key.

To install:

15. Install the key on the camshaft.
16. Heat the camshaft gear to 250°F (121°C) for 45 minutes. Lubricate the gear mount surface with Lubriplate 105®. Install the gear to the camshaft with the timing marks facing away from the shaft.
17. Lubricate the camshaft bores, lobes, journals and thrust washer with Lubriplate 105®.

➡Do not push the camshaft in too far or it may dislodge the plug in the rear of the camshaft bore, possibly creating a leak.

18. Install the camshaft and thrust washer so the "E" timing mark on the injection pump gear aligns with the "C" timing mark on the camshaft gear and the timing mark on the crankshaft gear align with those on the camshaft gear.
19. Install the thrust washer bolts and tighten to 18 ft. lbs. (24 Nm).
20. Check the end-play of the camshaft. The specification is 0.006-0.010 in. (0.152-0.254mm).
21. Check the backlash of the camshaft gear. The specification is 0.003-0.013 in. (0.080-0.330mm).
22. Install the tappets and pushrods and all other remaining components in the reverse order of removal.
23. Start the engine and check for leaks.

INSPECTION

1. Check the run-out with a dial indicator. Support journals 1 and 4 on V-blocks and set the dial indicator on 2 and 3. Run-out should be less than 0.008 in. (0.02mm). If run-out exceeds 0.002 in. (0.05mm), replace the camshaft.
2. Check the cam profile by measuring the cam long and short diameters with a micrometer. Inspect the cam profile for wear or damage. The long diameter should measure 1.835 in. (46.615mm); the short diameter should measure 1.55 in. (39.426mm). If the cam profile is worn or damaged, or the diameters differ from standards by 0.02 in. (0.5mm) or more, replace the camshaft.
3. Check the camshaft journals for damage and wear. If excessively worn or damaged, the camshaft must be replaced.
4. Check the journal ODs as given in the chart. Check the bearing IDs and figure the clearances. Clearances are given in the chart.
5. Bearings are removed and installed with tool No. MH061070.

Camshaft End-Play

➧ See Figure 167

➡On all gasoline V8 engines, prying against the aluminum-nylon camshaft sprocket, with the valve train load on the camshaft, can break or damage the sprocket. Therefore, the rocker arm adjusting nuts must be backed off, or the rocker arm and shaft assembly must be loosened sufficiently to free the camshaft. After checking the camshaft end-play, check the valve clearance. Adjust if required (refer to the procedure in this section).

1. Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft sprocket attaching screw.
2. Zero the dial indicator. Position a prybar between the camshaft gear and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with the specifications.
3. If the end-play is excessive, check the spacer for correct installation before it is removed. If the spacer is correctly installed, replace the thrust plate.
4. Remove the dial indicator.

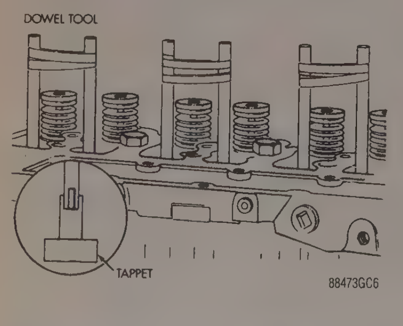


Fig. 164 Insert the tappet dowels to hold the tappets up securely—diesel engine

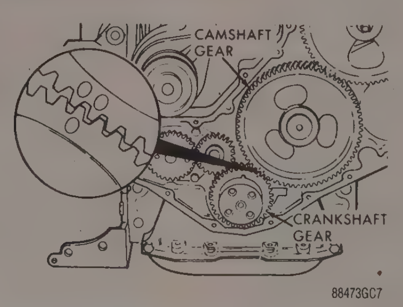


Fig. 165 Align the crankshaft to the camshaft on the diesel engine as shown

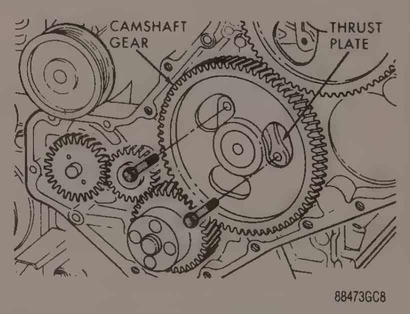


Fig. 166 Insert the thrust plate bolts on the diesel engine in the location shown

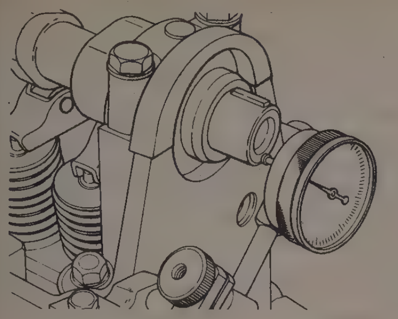


Fig. 167 Use a dial indicator to check camshaft end-play—2.5L engine camshaft shown

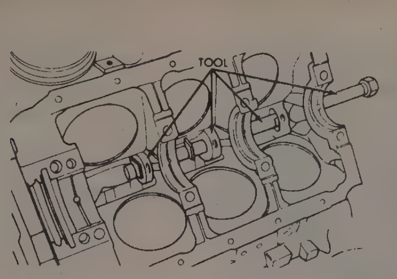


Fig. 168 Use the special tool to remove/install the camshaft bearings—V6 engine shown

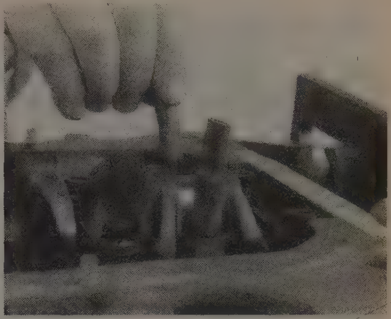


Fig. 169 Place rubber hoses over the connecting rod studs to protect the crankshaft and cylinders

Camshaft Bearing

REMOVAL & INSTALLATION

V6, V8 and V10 Engines

➧ See Figure 168

1. Remove the engine following the procedures in this section and install it on a workstand.
2. Remove the camshaft, flywheel and crankshaft, following the appropriate procedures. Push the pistons to the top of the cylinder.
3. Remove the camshaft rear bearing bore plug. Remove the camshaft bearings with bearing removal tool No. C–3132–A, or equivalent.
4. Select the proper size expanding collet and back-up nut and assemble on the mandrel. With the expanding collet collapsed, install the collet assembly in the camshaft bearing and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.
5. Assemble the puller screw and extension (if necessary) and install on the expanding mandrel. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.
6. To remove the front bearing, install the puller from the rear of the cylinder block.
7. Position the new bearings at the bearing bores, and press them in place. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. Failure to use the correct expanding collet can cause severe bearing damage. Align the oil holes in the bearings with the oil holes in the cylinder block before pressing bearings into place.
8. Install the camshaft rear bearing bore plug.
9. Install the camshaft, crankshaft, flywheel and related parts, following the appropriate procedures.

✻✻ WARNING

Make sure the plug does not leak.

10. Install the engine in the truck, following procedures described earlier in this section.

Pistons and Connecting Rods

REMOVAL

➧ See Figures 169, 170, 171 and 172

Engine In Vehicle

1. Remove the cylinder head.
2. Remove the timing chain/gears.
3. Remove the oil pan.

➡After removing the connecting rod cap and bearing, place a short length of rubber hose over the rod bolts to prevent cylinder wall and crank journal scoring when removing or installing the piston and rod assembly.

4. Pistons should be removed following the firing order of the engine from the top of the cylinder block. Turn the crankshaft until the piston to be removed is at the bottom of its stroke.

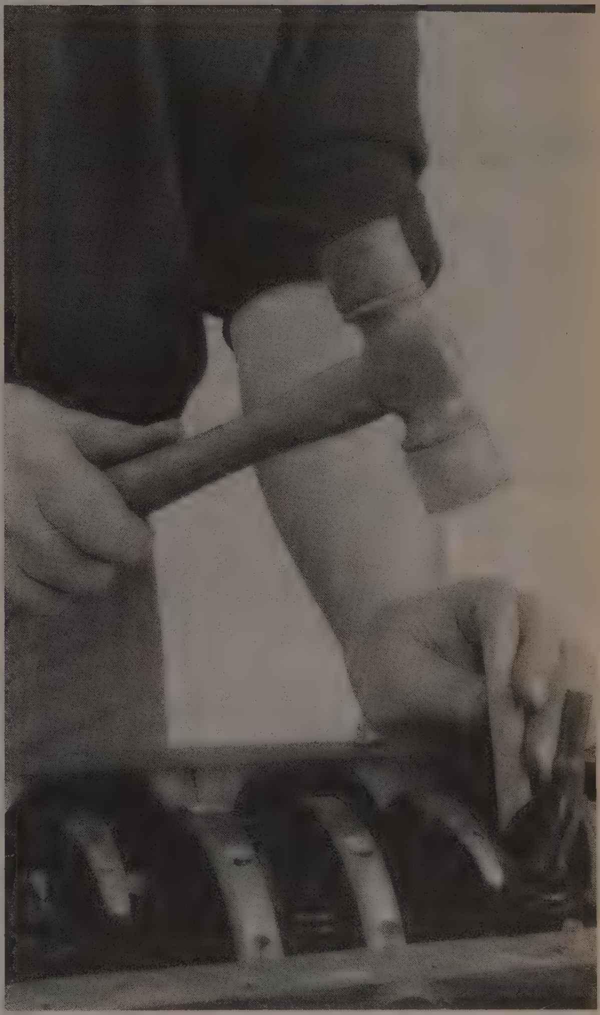


Fig. 170 Carefully tap the piston out of the bore using a wooden dowel

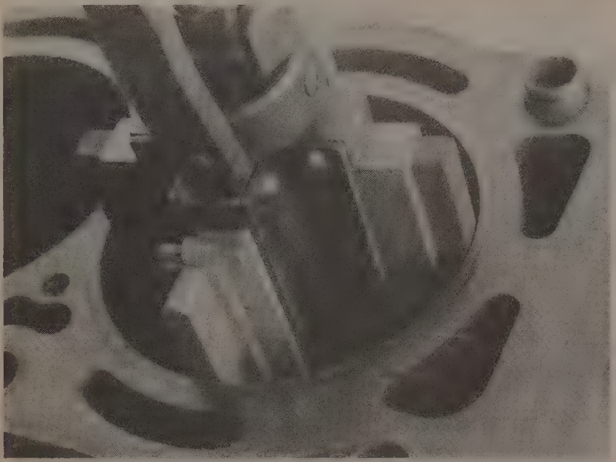

TCCS3916

Fig. 171 Use a ridge cutter to remove the ridge from the cylinder bore

WARNING

Be careful not to nick the crankshaft journals. On V10 engines, DO NOT remove the black coating on the skirt. This is a factory applied dry lubricant.

5. Place a cloth on the head of the piston to be removed and, using a ridge cutter (reamer), remove the deposits from the upper end of the cylinder bore.

WARNING

Never remove more than 1/32 in.(0.8mm) from the ring travel area when removing the ridges!

6. Mark all connecting rod bearing caps so that they may be returned to their original locations in the engine. The connecting rod caps are usually marked. The marks must be matched when re-assembling the engine. Mark all pistons so they can be returned to their original cylinders.

Engine Out Of Vehicle

GASOLINE ENGINES

See Figures 173 and 174

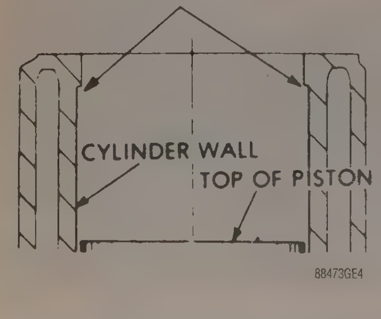
On the 5.2L and 5.9L engines, 0.001 in. (0.025mm) undersize journals are indicated by marks on the No. 8 crankshaft counterweight. If the R or M is followed by an X, all those journals are 0.010 in. (0.25mm) undersize. Upper and lower bearing inserts are not interchangeable on any of the V8 engines due to the oil hole and V-groove in the upper bearings. On the 5.2L and 5.9L engine lower bearing halves No. 1, No. 2 and No. 4 are interchangeable; No. 1, No. 2 and No. 4 upper bearing halves are interchangeable, No. 3 bearing is the thrust bearing and No. 5 is the wider rear main bearing. Remove main bearing caps one at a time and check clearance. Check number of cap for proper location.

1. With the engine removed from the vehicle and placed on a workstand, disconnect the spark plug wires from the spark plugs, and remove the wires and bracket assembly from the attaching stud on the valve cylinder head cover(s), if so equipped. Disconnect the coil to distributor high tension lead at the coil. Disconnect the coil to distributor high tension lead at the coil. Remove the distributor cap and spark plug wires as an assembly. Remove the spark plugs to allow easy rotation of the crankshaft.
2. Remove the fuel pump and oil filter. Slide the water pump by-pass hose clamp (if so equipped) toward the water pump. Remove the alternator and mounting brackets.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the capscrew and washer from the end of the crankshaft. Install a universal puller on the crankshaft vibration damper and remove the damper.
4. Remove the cylinder front cover and crankshaft gear, refer to the cylinder front cover and timing chain procedures in this section.
5. Invert the engine on the workstand. Remove the clutch pressure plate and disc (manual shift transmission). Remove the flywheel and engine rear cover plate. Remove the oil pan and gasket. Remove the oil pump.
6. Make sure all bearing caps (main and connecting rod) are scribe-marked so that they can be installed in their original locations. And number each rod and cap with its cylinder number for correct assembly. Turn the crankshaft until the connecting rod from which the cap is being removed is down, and remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all the connecting rod bearing caps are removed.
7. Remove the main bearing caps.
8. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. Handle the crankshaft with care to avoid possible damage to the finished surfaces.
9. Remove the rear journal seal from the block and rear main bearing cap.
10. Remove the main bearing inserts from the block and bearing caps.
11. Remove the connecting rod bearing inserts from the connecting rods and caps.
12. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.

DIESEL ENGINES

➡For 1994–96 models, the turbocharged intercooler piston has a Ni-Resist insert with a keystone profile for the top compression ring. The new piston has a new design bowl and a 0.275 in. (7mm) longer piston ring than 1989–93 models. These pistons are not interchangeable with the earlier models.

1. Remove the cylinder head from the block.
2. Remove the oil pan and suction pump.
3. If the cylinder bores have ridges, use a ridge reamer to remove them prior to piston removal. Do NOT remove more metal than is necessary to remove the ridge.
4. If the cylinders have ridges, they are oversize and will need boring.



88473GE4

Fig. 172 The ridge caused by cylinder wear gets thicker as mileage increases

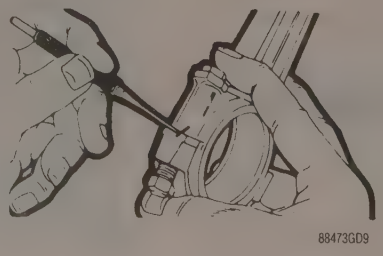
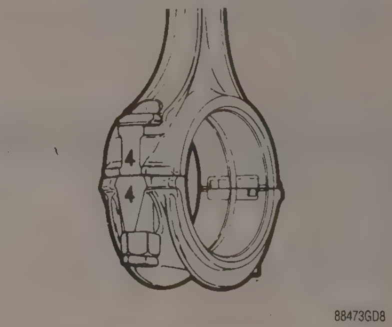

88473GD9

Fig. 173 Be careful to scribe-mark the connecting rods to their caps for correct reassembly



88473GD8

Fig. 174 Number the rod, cap and cylinder so that the parts will be reassembled in their original positions

5. Use a hammer and steel stamp to mark the cylinder number onto each connecting rod cap. Mark the cylinder number onto the top of each piston.

6. Remove the connecting rod bolts and rod caps. Use care so the cylinder bores and connecting rods are not damaged.

7. Use a hammer handle or similar wooden object to push the piston and rod through the cylinder bore.

8. Store the piston/rod assemblies in a suitable rack.

9. If a piston must be replaced, replace with the same part number (grading) that was removed.

CLEANING AND INSPECTION

See Figures 175 thru 187

This procedure is for the pistons and their cylinder bores. For rod bearings, see the rod bearing replacement procedure.

WARNING

Do not use a wire brush or caustic solvent (acids, etc.) on pistons. Inspect the pistons for scuffing, scoring, cracks, pitting, or excessive ring groove wear. If these are evident, the piston must be replaced. The piston should also be checked in relation to the cylinder diameter.

1. Using a telescoping gauge and micrometer, or a dial gauge, measure the cylinder bore diameter perpendicular (90%) to the piston pin, 2½ in.(64mm) below the cylinder block deck (surface where the block mates with the heads). Then, with the micrometer, measure the piston perpendicular to its wrist pin on the skirt. If the difference between these measurements is within specifications or slightly below (after the cylinders have been bored or honed), finish honing is all that is necessary.

2. With a cylinder bore gauge, measure the cylinder bore for out-of-round and taper. Taper is the difference in wear between two bore measurements in any cylinder. Allowable out-of-round for the 2.5L engine is 0.002 in. (0.050mm) or less, and allowable taper is 0.005 in. (0.125mm) or less. For V6, V8 and V10 engines, maximum out-of-round is 0.005 in. (0.127mm), and maximum taper is 0.010 in. (0.254mm). If these specifications are exceeded, the cylinder block must be honed or re-bored and fitted with new pistons and rings.

➡If one cylinder bore is rebored to a given oversize, all other sleeves must be rebored to the same oversize.

3. If the clearance is excessive, try to obtain a slightly larger piston to bring clearance to within specifications. If this is not possible, obtain the first oversize piston and hone (or if necessary, bore) the cylinder to size.

4. If the used piston is not acceptable, check the service piston size and determine if a new piston can be selected. Service pistons are available in standard, high limit and standard oversize.

5. If the cylinder bore must be reconditioned, measure the new piston diameter, then hone the cylinder bore to obtain the preferred clearance (refer to cylinder honing in this section).

6. Select a new piston and mark the piston to identify the cylinder for which it was fitted. On some vehicles, oversize pistons may be found. These pistons will be 0.010 in. (0.254mm) oversize.

7. If the cylinder bore is in satisfactory condition, check the ring end-gap as follows:
   a. Compress the piston rings to be used in a cylinder, one at a time, into that cylinder.
   b. Squirt clean oil into the cylinder, so that the rings and the top 2 in. (51mm) of cylinder wall are coated.
   c. Using an inverted piston, press the rings approximately 1 in. (25mm) below the deck of the block. Measure the ring end-gap with the feeler gauge, and compare to the Ring Gap chart in this section.
   d. If necessary, carefully pull the ring out of the cylinder and file the ends squarely with a fine file to obtain the proper clearance.

8. Before checking the ring side clearance, be sure that the ring grooves are clean and free of carbon, sludge, or grit. Check the ring side clearance by installing rings on the piston, and inserting a feeler gauge of the correct dimension between the ring and the lower land. The gauge should slide freely around the ring circumference without binding. Any wear will form a step on the lower land. Remove any pistons having high steps.

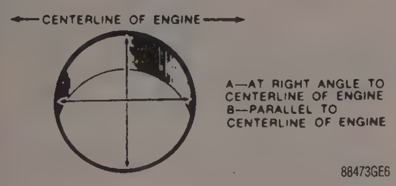

CENTERLINE OF ENGINE
A—AT RIGHT ANGLE TO CENTERLINE OF ENGINE
B—PARALLEL TO CENTERLINE OF ENGINE
88473GE6

Fig. 175 Take the top measurement ½ in. (13mm) below the top. Take the bottom measurement ½ in. (13mm) above the top of the piston at BDC

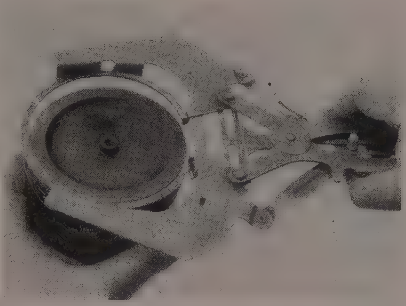


Fig. 176 Use a ring expander tool to remove the piston rings

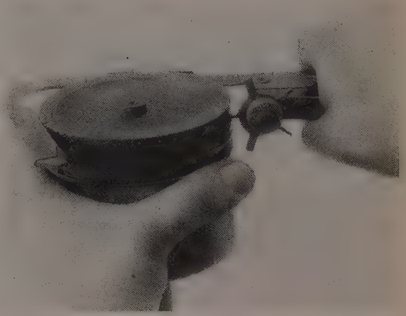


Fig. 177 Clean the piston grooves using a ring groove cleaner

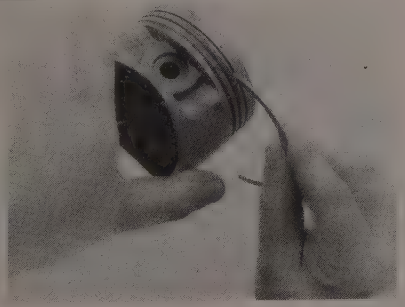


Fig. 178 You can use a piece of an old ring to clean the piston grooves, BUT be careful, the ring is sharp

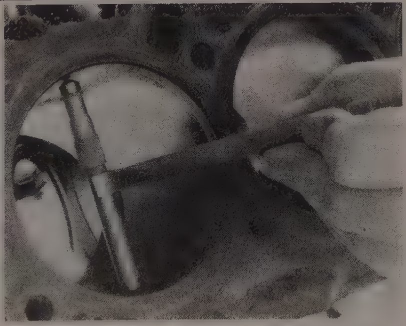


Fig. 179 A telescoping gauge may be used to measure the cylinder bore diameter

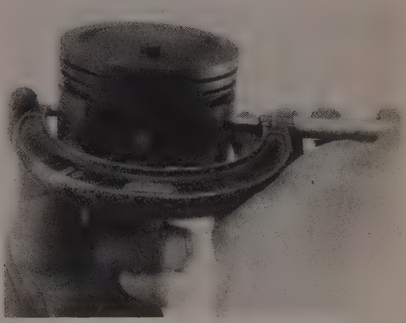


Fig. 180 Measure the piston's outer diameter using a micrometer

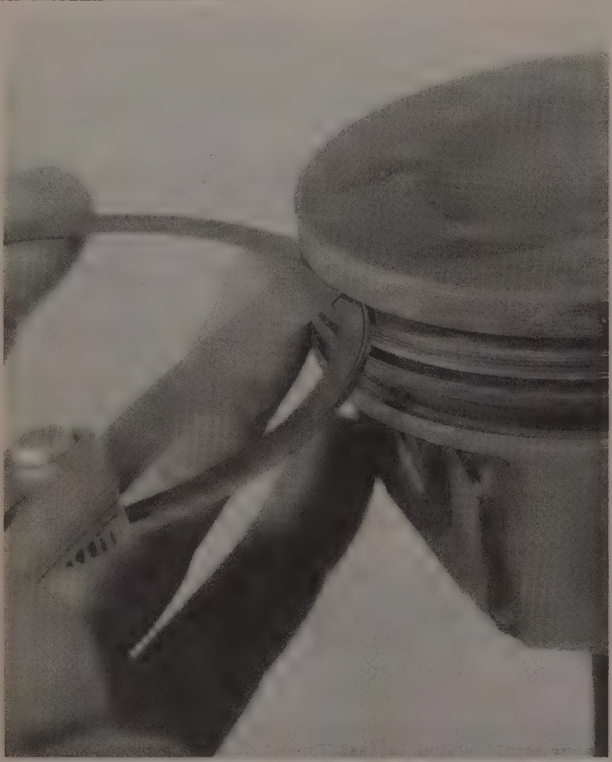


Fig. 181 Checking the ring-to-ring groove clearance

9. On diesels, insert the gauge between the ring and the upper land. If the piston grooves have worn to the extent that relatively high steps exist on the lower land, the piston should be replaced, because these will interfere with the operation of the new rings and ring clearance will be excessive.

➡Piston rings are not furnished in oversize widths to compensate for ring groove wear.

CYLINDER HONING

▶ See Figures 188, 189 and 190

➡Unless you have experience and access to the proper equipment, cylinder honing and/or boring should be performed by a reputable, professional mechanic who has the know-how to do this critical job correctly. In some cases, clean-up honing can be done with the cylinder block in the vehicle, but most excessive honing and all cylinder boring must be done with the block stripped and removed from the vehicle.

1. When cylinders are being honed, follow the manufacturer's recommendations for the use of the hone.
2. Occasionally, during the honing operation, the cylinder bore should be thoroughly cleaned and the selected piston checked for correct fit.

➡Do not grind more than necessary to obtain specifications.

3. When finish-honing a cylinder bore, the hone should be moved up and down at a sufficient speed to obtain a very fine uniform surface finish in a cross-hatch pattern of approximately 45–65°included angle. The finish marks should be clean but not sharp, and free from imbedded particles, torn or folded metal.
4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone the remaining cylinders.

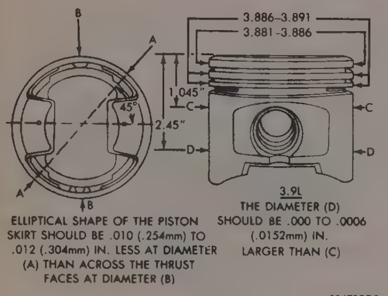

B
A
3.886–3.891
3.881–3.886
1.045"
C
45°
2.45"
D
A
B
ELLIPTICAL SHAPE OF THE PISTON SKIRT SHOULD BE .010 (.254mm) TO .012 (.304mm) IN. LESS AT DIAMETER (A) THAN ACROSS THE THRUST FACES AT DIAMETER (B)
3.9L
THE DIAMETER (D) SHOULD BE .000 TO .0006 (.0152mm) IN. LARGER THAN (C)
88473GD6

Fig. 182 Critical dimensions of the stock factory piston—3.9L V6 engine

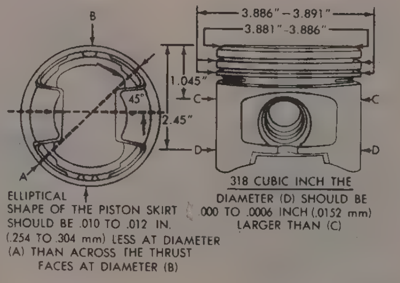

B
3.886"–3.891"
3.881"–3.886"
1.045"
C
45°
2.45"
D
A
ELLIPTICAL SHAPE OF THE PISTON SKIRT SHOULD BE .010 TO .012 IN. (.254 TO .304 mm) LESS AT DIAMETER (A) THAN ACROSS THE THRUST FACES AT DIAMETER (B)
318 CUBIC INCH THE DIAMETER (D) SHOULD BE .000 TO .0006 INCH (.0152 mm) LARGER THAN (C)
88473GD4

Fig. 183 Critical dimensions of the stock factory piston—5.2L V8 engine

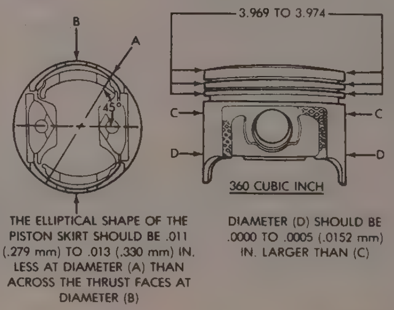

B
A
45°
3.969 TO 3.974
C
D
360 CUBIC INCH
THE ELLIPTICAL SHAPE OF THE PISTON SKIRT SHOULD BE .011 (.279 mm) TO .013 (.330 mm) IN. LESS AT DIAMETER (A) THAN ACROSS THE THRUST FACES AT DIAMETER (B)
DIAMETER (D) SHOULD BE .0000 TO .0005 (.0152 mm) IN. LARGER THAN (C)
88473GD5

Fig. 184 Critical dimensions of the stock factory piston—5.9L V8 engine

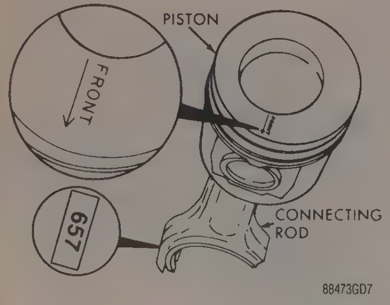

PISTON
FRONT
657
CONNECTING ROD
88473GD7

Fig. 185 Diesel piston markings show which way faces front

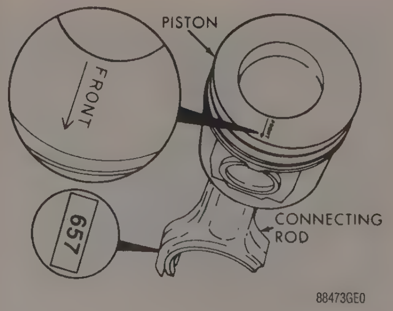

PISTON
FRONT
657
CONNECTING ROD
88473GE0

Fig. 186 Check the piston ring side clearance with a feeler gauge as shown

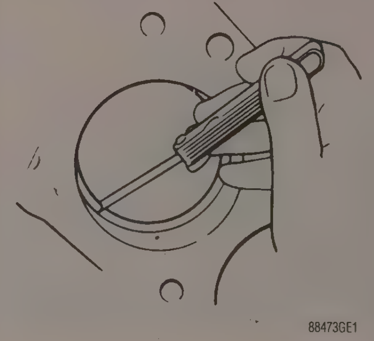


Fig. 187 Checking the piston ring gap

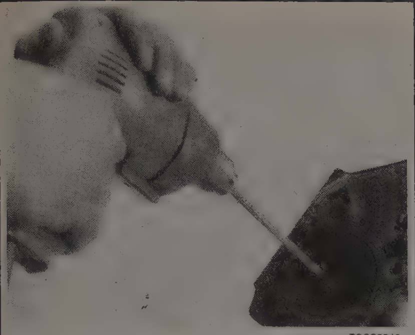


Fig. 188 Removing cylinder glazing using a flexible hone

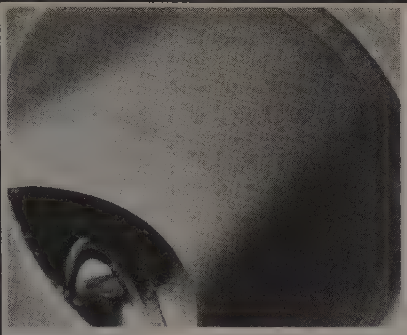


Fig. 189 A properly cross-hatched cylinder bore

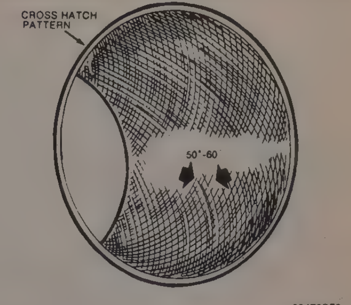

CROSS HATCH PATTERN
50°-60°
88473GE3

Fig. 190 The cylinder bore cross-hatch pattern should be at an approximately 50–60 degree angle as shown

WARNING

Handle the pistons with care. Do not attempt to force the pistons through the cylinders until the cylinders have been honed to the correct size. Pistons can be distorted through careless handling.

5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. If is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores.
6. The bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth. CYLINDERS SHOULD NOT BE CLEANED WITH KEROSENE OR GASOLINE! Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

PISTON PIN REPLACEMENT

See Figure 191

All of the gasoline engines covered in this guide utilize pressed-in wrist pins which can only be removed by an arbor press. The diesel piston pins are removed in the same way, except the pistons must be heated before the wrist pins are pressed out.

PISTON RING REPLACEMENT

See Figures 192 thru 198

A piston ring expander is necessary for removing the piston rings without damaging them; any other method (screwdriver, blades, pliers, etc.) usually results in the rings being bent, scratched or distorted, or the piston itself being damaged. When the rings are removed, clean the ring grooves using an appro-

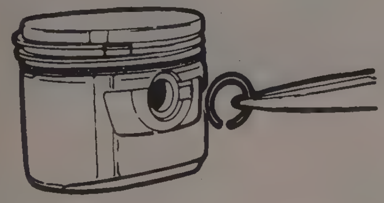


Fig. 191 Use needlenosed or snapring pliers to remove the piston pin clip prior to pressing out the pin, and again after pin replacement

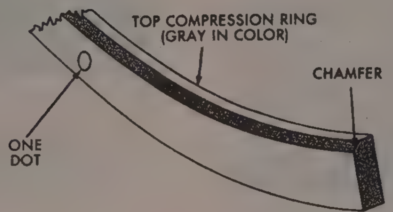

TOP COMPRESSION RING (GRAY IN COLOR)
CHAMFER
ONE DOT
88473GJ8

Fig. 192 A common factory top compression ring—1994–96 engines

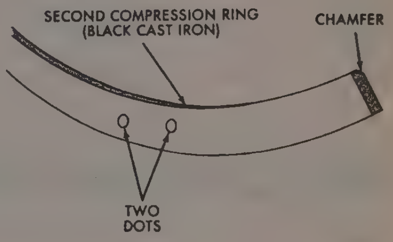

SECOND COMPRESSION RING (BLACK CAST IRON)
CHAMFER
TWO DOTS
88473GJ7

Fig. 193 A common factory second compression ring—1994–96 engines

Fig. 194 Most rings are marked to show which side should face upward

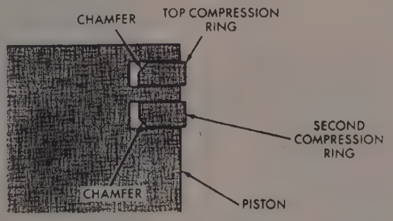

CHAMFER
TOP COMPRESSION RING
SECOND COMPRESSION RING
CHAMFER
PISTON
88473GJ9

Fig. 195 Install chamfered rings as shown in this cross-sectional view

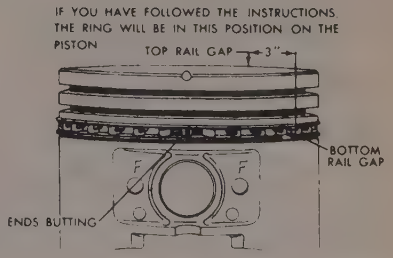
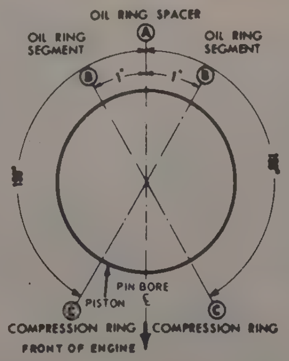
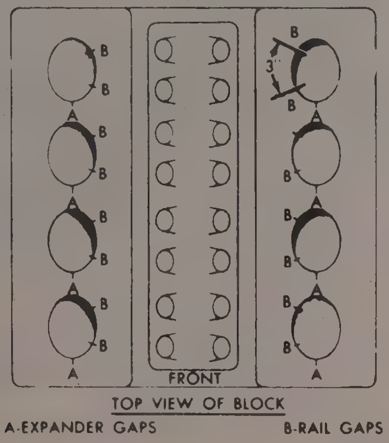

IF YOU HAVE FOLLOWED THE INSTRUCTIONS, THE RING WILL BE IN THIS POSITION ON THE PISTON
TOP RAIL GAP
3"
BOTTOM RAIL GAP
ENDS BUTTING
F
F
88473GD3

Fig. 196 Piston ring gap positioning—V6 and V8 engines



88473GE5

Fig. 197 Make sure the gap spacing is correct for each ring



88473GD2

Fig. 198 Piston ring gap locations on the V8 engine—V6 engine is similar

priate ring groove cleaning tool, using care not to cut too deeply. Thoroughly clean all carbon and varnish from the piston with solvent.

WARNING

The piston ring end-gap should also be checked while the rings are removed from the pistons. Incorrect end-gap indicates that the wrong size rings are being used, and ring breakage could occur again.

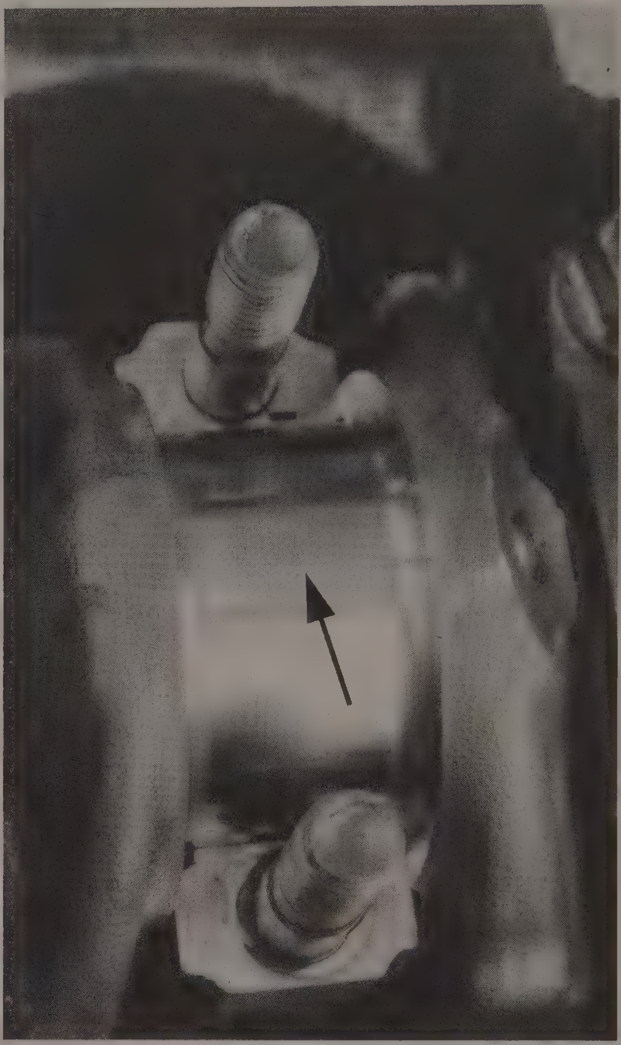
Piston rings should be installed using a piston ring expander so that their ends are at three equal spacings. Avoid installing rings with their ends in-line with the piston pin bosses and the thrust direction. When installing new rings, refer to the installation diagram furnished with the new parts. Position the rings on the piston as illustrated; spacing of the various piston ring gaps is crucial to proper oil retention and even cylinder wear.

ROD BEARING REPLACEMENT

See Figures 199 and 200

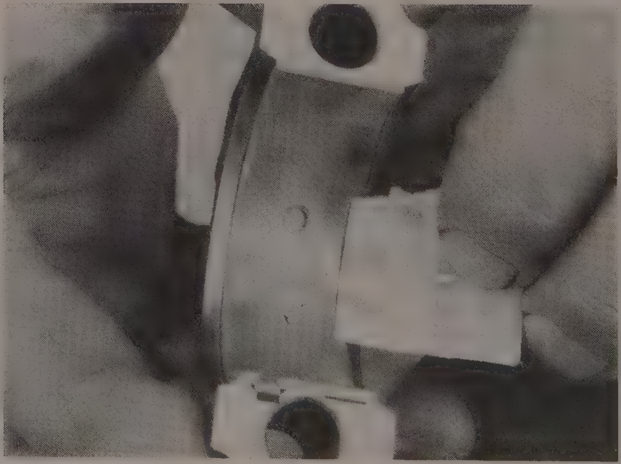
Connecting rod bearings for the engines covered in this guide consist of two halves or shells which are interchangeable in the rod and cap. when the shells are placed in position, the ends extend slightly beyond the rod and cap surfaces so that when the rod bolts are torqued the shells will be clamped tightly in place to insure positive seating and to prevent turning. A tang holds the shells in place.

➡The ends of the bearing shells must never be filed flush with the mating surfaces of the rod and cap.



TCCS3243

Fig. 199 Apply a strip of gauging material to the bearing journal, then install and tighten the cap



TCCS3912

Fig. 200 After the cap is removed again, use the scale supplied with the gauging material to check clearances

If a rod bearing becomes noisy or is worn so that its clearance on the crank journal is sloppy, a new bearing of the correct undersize must be selected and installed since there is no provision for adjustment.

WARNING

Under no circumstances should the rod end or cap be filed to adjust the bearing clearance, nor should shims of any kind be used.

Inspect the rod bearings while the rod assemblies are out of the engine. If the shells are scored or show flaking, they should be replaced. If they are in good shape, check for proper clearance on the crank journal (see the following). Any scoring or ridges on the crank journal means the crankshaft must be reground and fitted with undersized bearings, or replaced.

➡Make sure connecting rods and their caps are kept together, and that the caps are installed in the proper direction.

Replacement bearings are available in standard size, and in undersizes for a reground crankshaft. Connecting rod-to-crankshaft bearing clearance is checked using Plastigage®or an equivalent gauging material at either the top or bottom of each crank journal. the Plastigage®has a range of 0 to 0.003 in. (0.076mm).

1. Remove the rod cap with the bearing shell. Completely clean the bearing shell and the crankshaft journal, and blow any oil from the oil hole in the crankshaft.

➡The journal surfaces and bearing shells must be completely free of oil, because Plastigage®is soluble in oil.

2. Place a strip of Plastigage®lengthwise along the bottom center of the lower bearing shell, then install the cap with shell and tighten the bolt or nuts to specification. DO NOT TURN the crankshaft with the Plastigage®installed in the bearing.
3. Remove the bearing cap with the shell. The flattened Plastigage®will be found sticking to either the bearing shell or crank journal. Do not remove it yet.
4. Use the printed scale on the Plastigage®envelope to measure the flattened material at its widest point. The number within the scale which most closely corresponds to the width of the Plastigage®indicated bearing clearance in thousandths of an inch.
5. Check the specifications chart in this section for the desired clearance. It is advisable to install a new bearing if clearance exceeds 0.003 in. (0.076mm); however, if the bearing is in good condition and is not being checked because of bearing noise, bearing replacement is not necessary.
6. If you are installing new bearings, try a standard size, then each undersize in order until one is found that is within the specified limits when checked for clearance with Plastigage®. Each under size has its size stamped on it.
7. When the proper size shell is found, clean off the Plastigage®material from the shell, oil the bearing thoroughly, reinstall the cap with its shell and tighten the rod bolt nuts to specification.

➡With the proper bearing selected and the nuts torqued, it should be possible to move the connecting rod back and forth freely on the crank journal as allowed by the specified connecting rod end clearance. If the rod cannot be moved, either the rod bearing is too far undersize or the rod is misaligned.

INSTALLATION

▶ See Figures 191, 201 thru 205

If they were separated, install the connecting rod to the piston, making sure the piston installation notches and any marks on the rod are in proper relation to one another. Lubricate the wrist pin with clean engine oil and install the pin into the rod and piston assembly by using an arbor press as required. Install the wrist pin snaprings if equipped, and rotate them in their grooves to make sure they are seated.

➡Install the pistons in their original bores, if you are reusing the same pistons. Using a wooden hammer handle, push the rod into the bore while guiding the rod onto the journal.

On the 2.5L engine, position the valve cutouts in the piston head toward the manifold side of the engine. On all V6, V8 and V10 engines, the notch on the top of each piston must face the front of the engine. On diesel engines, position the piston in the cylinder with the front mark facing forward.

To position the connecting rod correctly, the larger chamfer of the lower connecting rod bore must face to the rear on the right bank and to the front on the left bank.

1. Make sure the connecting rod bearings (including the end cap) are of the correct size and properly installed.
2. Fit rubber hoses over the connecting rod bolt to protect the crankshaft journals, as in the piston removal procedure. Coat the rod bearings with clean oil.
3. Using the proper ring compressor, insert the piston assembly into the cylinder so that the notch in the top of the piston faces the front of the engine (this assumes that the dimple or other markings on the connecting rods are in correct relation to the piston notch).
4. From beneath the engine, coat each crankshaft journal with clean oil. Pull the connecting rod, with the bearing shell in place, into position against the crankshaft journal.

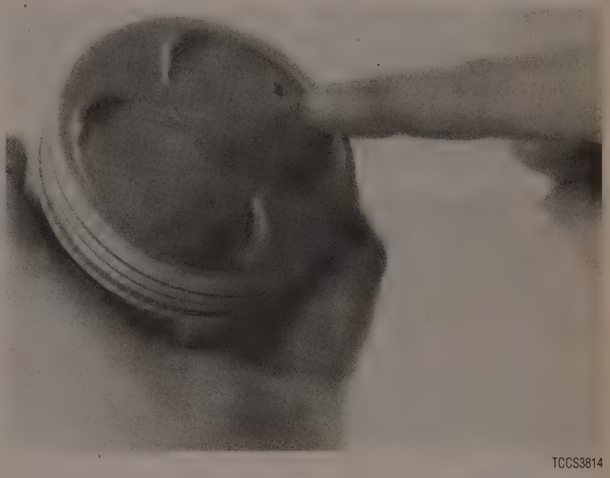


Fig. 201 Most pistons are marked to indicate their positioning in the engine

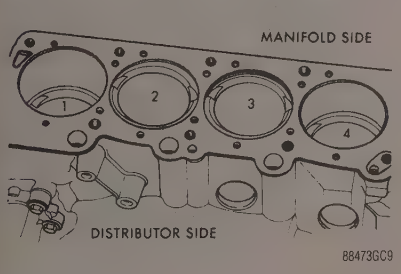


Fig. 202 Position the valve cutouts in the piston head toward the manifold side of the engine—2.5L engine

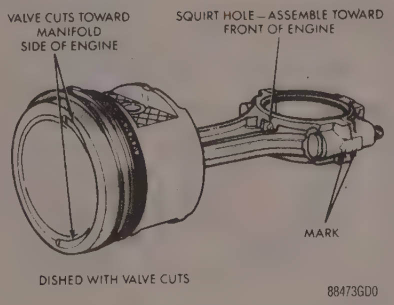

VALVE CUTS TOWARD MANIFOLD SIDE OF ENGINE
SQUIRT HOLE—ASSEMBLE TOWARD FRONT OF ENGINE
MARK
DISHED WITH VALVE CUTS
88473GD0

Fig. 203 Piston and connecting rod assembly—2.5L engine

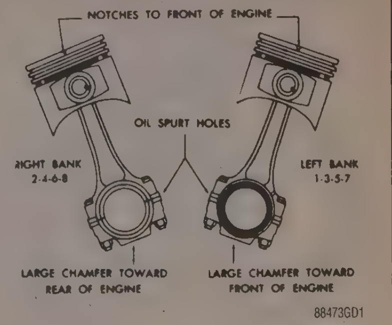

NOTCHES TO FRONT OF ENGINE
OIL SPURT HOLES
RIGHT BANK 2-4-6-8
LEFT BANK 1-3-5-7
LARGE CHAMFER TOWARD REAR OF ENGINE
LARGE CHAMFER TOWARD FRONT OF ENGINE
88473GD1

Fig. 204 Make sure the piston and connecting rod assemblies are correctly positioned—V8 engine pistons shown

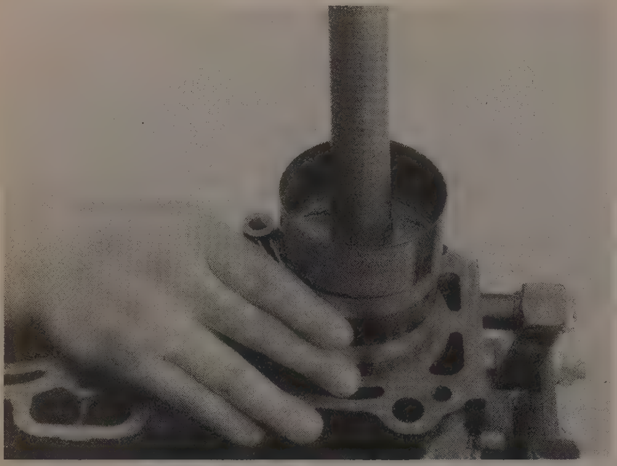


Fig. 205 Installing the piston into the block using a ring compressor and the handle of a hammer

5. Remove the rubber hoses. Install the bearing cap and cap nuts and tighten to specification.

➡When more than one rod and piston assembly are being installed, the connecting rod cap attaching nuts should only be tightened enough to keep each rod in position until all have been installed. This will ease the installation of the remaining piston assemblies.

6. Check the clearance between the sides of the connecting rods and the crankshaft using a feeler gauge. Spread the rods slightly with a screwdriver to insert the gauge. If clearance is below the minimum tolerance, the rod may be machined to provide adequate clearance. If clearance is excessive, substitute an unworn rod, and recheck. If clearance is still outside specifications, the crankshaft must be welded and reground, or replaced.
7. Install the oil pump if removed, and the oil pan.
8. Install the cylinder head(s) and intake manifold.

Rear Main Seal

The 3.9L and 5.2L engine rear main oil seal is a 2-piece, fitted rope type seal. The 5.9L engine rear main seal is a split rubber type in all cases. The upper half can be installed with the crankshaft in place. The 2 halves should always be replaced as a set.

REMOVAL & INSTALLATION

2.5L Engine

➧ See Figures 206 and 207

1. Disconnect the negative battery cable.
2. Remove the transmission or transaxle. Remove the flywheel of flexplate.
3. If there is any leakage coming from the rear seal retainer, drain the engine oil and remove the oil pan, if necessary. Remove the rear main oil seal retainer.

✻✻ CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

4. Remove the seal from the retainer.

To install:

5. Lightly coat the seal outer diameter with Loctite®Stud N' Bearing Mount, or equivalent.
6. Install the seal to the retainer.
7. If the retainer was removed, thoroughly clean and dry the retainer to block sealing surfaces and install a new gasket or apply silicone sealer and install the retainer. Install the pan, if it was removed.
8. Install the flywheel or flexplate and the transmission or transaxle.
9. Connect the negative battery cable and check for leaks.

3.9L and 5.2L Engines

➧ See Figures 208, 209, 210, 211 and 212

1. Raise the vehicle and support it safely.
2. Drain the engine oil. Remove the oil pan and oil pump.
3. Remove the rear main bearing cap.
4. Remove the lower seal from the cap.
5. To remove the upper rope seal, use Oil Seal Remover and Installer Kit KD-492, or equivalent, following the instructions provided with the tool.

To install:

6. Wipe the crankshaft surface clean and coat it lightly with oil.
7. Use Oil Seal Remover and Installer Kit KD-492 or equivalent to install the upper rope seal. Trim the ends of the upper seal to eliminate frayed ends.
8. Install the lower rope seal in the main cap so that both ends protrude. Use tool C-3511, or equivalent, to seat the seal in its groove. Cut off the portions of the seal that extend above the cap on both sides and install the end seals to the cap.
9. Install the main cap to the block and tighten the bolts to 85 ft. lbs. (115 Nm).
10. Install the oil pan and fill the engine with the proper amount of oil.
11. Connect the negative battery cable and check for leaks.

5.9L Engine

➧ See Figures 210 and 211

1. Raise the vehicle and support safely. Drain the engine oil. Remove the oil pan and oil pump.

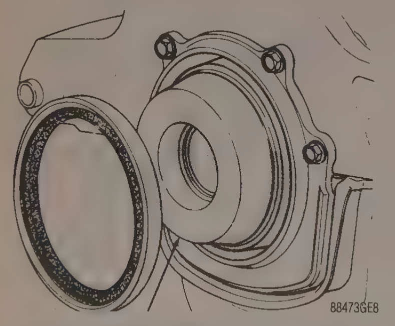


Fig. 206 Use a prytool to extract the rear crankshaft oil seal—2.5L engine

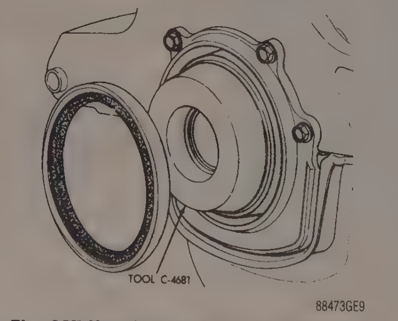


Fig. 207 Use the special tool, or equivalent, to press in the rear crankshaft oil seal—2.5L engine

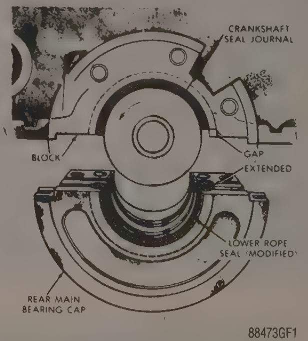


Fig. 208 A modified rear main bearing rope seal—V6 and 5.2L V8 engines

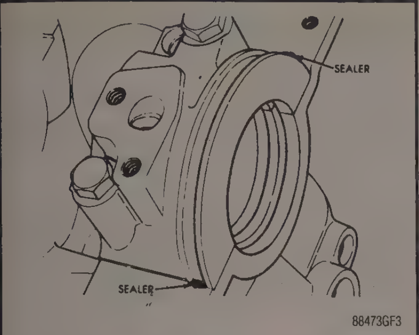


Fig. 209 Apply sealer to the indicated areas before installing the oil pan—V6 and 5.2L V8 engines

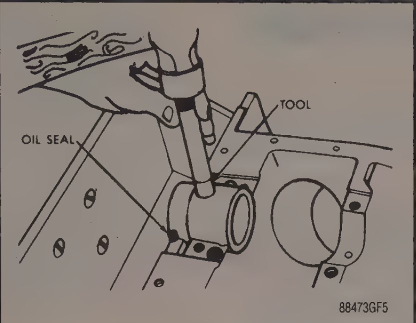


Fig. 210 Use the special tool shown to install the upper and lower oil seals—V6 and V8 engines

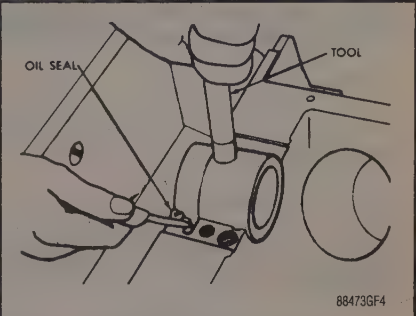


Fig. 211 Trim the oil seal to eliminate the frayed ends

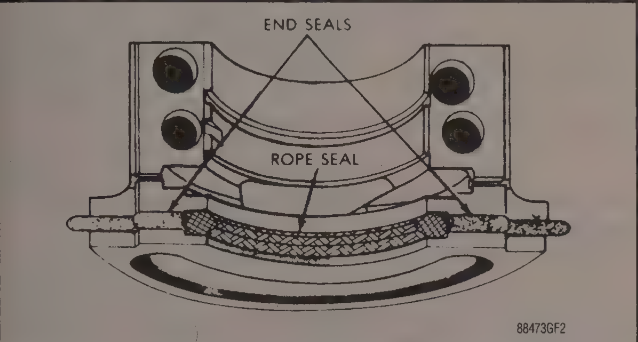


Fig. 212 Position the lower rope seal and end seals in the rear main bearing cap—5.2L engine

CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

2. Remove the rear main bearing cap.
3. Remove the lower seal from the cap.
4. To remove the upper seal, press on one end of the seal with a small blunt tool, rotate the crankshaft slightly and pull out the other end of the seal.

To install:

5. Wipe the crankshaft surface clean and coat it lightly with oil.
6. When installing the upper seal, hold the seal (with the paint stripe to the rear) tightly against the crankshaft and rotate the crankshaft while sliding the seal into the groove. If any rubber has peeled off of the back of the new seal, do not use it; it will leak.
7. When installing the lower rubber seal, make sure the paint stripe is positioned to the rear and place a drop of sealer next to both ends of the seal.
8. Install the main cap to the block and tighten the bolts to 85 ft. lbs. (115 Nm).
9. Install the oil pump and pan and fill the engine with the proper amount of oil.
10. Connect the negative battery cable and check for leaks.

8.0L Engine

See Figure 213

1. Remove the transmission.
2. Remove the oil pan.
3. Remove the rear seal retainer. Discard the oil seal and gasket.

To install:

4. Wash all parts in a safe solvent and inspect carefully for wear or damage.
5. Position the new seal in the retainer.
6. Position the retainer and oil seal over the crankshaft using special tool No. 6687, or equivalent. Install the bolts, tightening them to 16 ft. lbs. (22 Nm).
7. Check that the seal surface is within 0.020 in. (0.508mm) full indicator movement relative to the rear face of the crankshaft. If it is out of limits, use a soft face hammer to gently tap the high side into the retainer.
8. Seal the split line with a small amount of a suitable silicon rubber adhesive sealant.
9. Install the oil pan.
10. Install the transmission.

Diesel Engine

The rear crankshaft seal is mounted in a housing that is bolted to the rear of the block. A double-lipped Teflon®seal is used.

1. Disconnect the negative battery cable.
2. Remove the transmission.
3. Remove the clutch cover and plate, if equipped.
4. Remove the flywheel.
5. Drill two 0.118 in. (3mm) holes 180°apart into the seals. Be extremely careful not to drill against the crankshaft.
6. Insert two No. 10 sheet metal screws and, using a slide hammer, remove the rear seal.

To install:

7. Thoroughly clean and dry the crankshaft surface. Do not oil the crankshaft or seal prior to installation or the seal will leak.
8. Install the seal pilot included in the replacement seal kit, on the crankshaft. Push the seal on the pilot and crankshaft. Remove the pilot.
9. If the new seal has a rubber outer diameter, lubricate it with soapy water. If the seal does not have a rubber outer diameter, use Loctite®277, or equivalent on the outer diameter.
10. Use the alignment tool to install the seal to the proper depth in the housing. Drive the seal in gradually and evenly until the alignment tool stops against the housing.

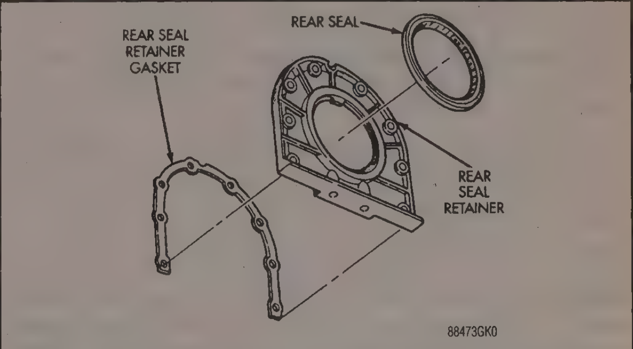


Fig. 213 Exploded view of the rear crankshaft main seal assembly—V10 engine

Crankshaft and Main Bearings

REMOVAL & INSTALLATION

Gasoline Engines

ENGINE IN THE VEHICLE

➡For V6, V8 and V10 engines, you will need a Crankshaft Main Bearing Remover/Installer Tool C–3059, or equivalent, to service the upper main bearing halves.

1. Remove the oil pan and gasket. For V6 and V8 engines, remove the oil pump. For V10 engines, remove the oil pump pick-up tube.

➡No crankshaft bearing parts are interchangeable. All parts, if being reused, should be marked or organized so as to allow reassembly in the exact same order as when removed. If the crankshaft is being replaced, all bearings (main and connecting rod bearings) should be replaced with new parts.

2. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations. Turn the crankshaft until the connecting rod from which the cap is being removed is down, and remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all the connecting rod bearing caps are removed.
3. Remove the main bearings caps.

**** WARNING**

Be careful not to nick the crankshaft journals. For V10 engine, DO NOT remove the black coating on the skirt. This is a factory applied dry lubricant.

4. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. Handle the crankshaft with care to avoid possible fracture to the finished surfaces.
5. Remove the rear journal seal from the block and rear main bearing cap.
6. Remove the main bearing inserts from the block and bearing caps.
7. Remove the connecting rod bearing inserts from the connecting rods and caps.

To install:

8. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.
9. Place the upper main bearing inserts in position in the bores with the tang fitting in the slot. Be sure the oil holes in the bearing inserts are aligned with the oil holes in the cylinder block.
10. Install the lower main bearing inserts in the bearing caps.

➡Refer to the torque specifications chart for the specifications for your particular engine.

11. Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap.
12. Dip the lip-type seal halves in clean engine oil. Install the seals in the bearing cap and block with the undercut side of the seal toward the front of the engine.

➡This procedure applies only to engines with two piece rear main bearing oil seals. Those having one piece seals will be installed after the crankshaft is in place.

13. Carefully install the crankshaft into place. Be careful not to damage the bearing surfaces.

ENGINE OUT OF THE VEHICLE

▸ See Figure 214

➡No crankshaft bearing parts are interchangeable. All parts, if being reused, should be marked or organized so as to allow reassembly in the exact same order as when removed. If the crankshaft is being replaced, all bearings (main and connecting rod bearings) should be replaced with new parts.

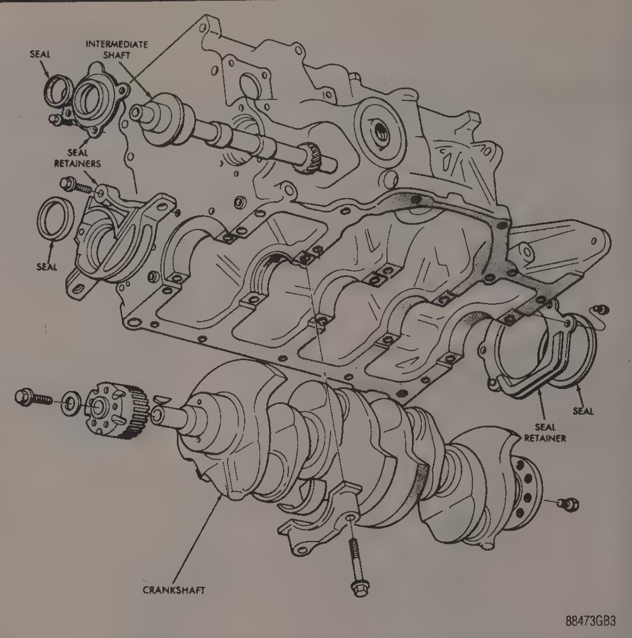


Fig. 214 Exploded view of the crankshaft and intermediate shaft assembly—2.5L engine

1. With the engine removed from the vehicle and placed in a workstand, disconnect the spark plug wires from the spark plugs and remove the wires and bracket assembly from the attaching stud on the valve cylinder head cover(s) if so equipped. Disconnect the coil to distributor high tension lead at the coil. Remove the distributor cap and spark plug wires as an assembly. Remove the spark plugs to allow easy rotation of the crankshaft.

➡For V6, V8 and V10 engines, you will need a Crankshaft Main Bearing Remover/Installer Tool C–3059, or equivalent, to service the upper main bearing halves.

2. Remove the fuel pump and oil filter. Slide the water pump by-pass hose clamp (if so equipped) toward the water pump. Remove the alternator and mounting brackets.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the capscrew and washer from the end of the crankshaft. Install a universal puller on the crankshaft vibration damper and remove the damper.
4. Remove the cylinder front cover and crankshaft gear, refer to the earlier procedure on removing the front cover, in this section.
5. Invert the engine on the workstand. Remove the clutch pressure plate and disc (manual shift transmission). Remove the flywheel and engine rear cover plate. Remove the oil pan and gasket. Remove the oil pump.
6. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations. Turn the crankshaft until the connecting rod from which the cap is being removed is down, and remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all the connecting rod bearing caps are removed.
7. Remove the main bearings caps.
8. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. Handle the crankshaft with care to avoid possible fracture to the finished surfaces.
9. Remove the rear journal seal from the block and rear main bearing cap.
10. Remove the main bearing inserts from the block and bearing caps.
11. Remove the connecting rod bearing inserts from the connecting rods and caps.

To install:

12. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.

✲✲✲ WARNING

Be careful not to nick the crankshaft journals. For V10 engine, DO NOT remove the black coating on the skirt. This is a factory applied dry lubricant.

13. Place the upper main bearing inserts in position in the bores with the tang fitting in the slot. Be sure the oil holes in the bearing inserts are aligned with the oil holes in the cylinder block.
14. Install the lower main bearing inserts in the bearing caps.

➡Refer to the torque specifications chart for the figures on your particular engine.

15. Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap.
16. Dip the lip-type seal halves in clean engine oil. Install the seals in the bearing cap and block with the undercut side of the seal toward the front of the engine.

➡This procedure applies only to engines with two piece rear main bearing oil seals. Those having one piece seals will be installed after the crankshaft is in place.

17. Carefully lower the crankshaft into place. Be careful not to damage the bearing surfaces.

Diesel Engines

1. With the engine secured on a workstand, with the cylinder head unfastened and placed aside, start by removing the top ridge from cylinder sleeve with a Ridge Reamer, tool C–3012, or equivalent.

➡Keep tops of pistons covered during this procedure.

2. As each piston and rod assembly is pushed out of bore, match the cap and rod assemblies. Also, identify the pistons and rods by cylinder.
3. Rotate the crankshaft to center each one of the connecting rods in the bore. Remove cap.
4. Turn the block sideways to remove the pistons and rod assemblies through the top of the block. Use bolt covers to protect journal surfaces. Push on upper bearing inserts with a hardwood blocks to remove assemblies.
5. Remove the main bearing caps from Nos. 1 and 7 bearings using puller C–3752-D (or its equivalent) and adapters. Remove the lower bearing inserts. Make sure to mark them as to cap number.
6. Remove the caps from Nos. 2 through 6 main bearings using the puller and adapters. Remove the lower bearing inserts. Make sure to mark them as to cap number.
7. Lift out the crankshaft.
8. Remove the upper bearing inserts. Identify the upper main bearings inserts, mate with corresponding lower main bearing inserts. Identify bearing pairs as to cap number.
9. Remove the thrust plates from No. 7 main bearing journal.

CLEANING AND INSPECTION

Crankshaft

➧ See Figure 214

➡Handle the crankshaft carefully to avoid damage to the finish surfaces. V10 engine crankshafts are specially coated with a dark, dry lubricant. This should not be removed.

1. Clean the crankshaft with solvent, and blow out all oil passages with compressed air.
2. Use crocus cloth to remove any sharp edges, burrs or other imperfections which might damage the oil seal during installation or cause premature seal wear.

➡Do not use crocus cloth to polish the seal surfaces. A finely polished surface may produce poor sealing or cause premature seal wear.

3. Inspect the main and connecting rod journals for cracks, scratches, grooves or scores.
4. Measure the diameter of each journal in at least four places to determine the out-of-round, taper or undersize condition.
5. On an engine with a manual transmission, check the fit of the clutch pilot bearing in the bore of the crankshaft. A needle roller bearing and adapter assembly is used as a clutch pilot bearing. It is inserted directly into the engine crankshaft. The bearing and adapter assembly cannot be serviced separately.
6. Inspect the pilot bearing, when used, for roughness, evidence of overheating or loss of lubricant. Replace if any of these conditions are found.

Main Bearings

➧ See Figure 215

1. Clean the bearing inserts and caps thoroughly in solvent, and dry them with compressed air.

➡Do not scrape varnish or gum deposits from the bearing shells.

2. Inspect each bearing carefully. Bearings that have a scored, chipped, or worn surface should be replaced.
3. The copper-lead bearing base may be visible through the bearing overlay in small localized areas. This may not mean that the bearing is excessively worn. It is not necessary to replace the bearing if the bearing clearance is within recommended specifications.
4. Check the clearance of each main bearing by using the following procedure:
    a. Place a piece of Plastigage®or equivalent on the bearing surface across the full width of the bearing cap and about 1/4 in. (6mm) off center.
    b. Install the cap and tighten the bolts to specification. Do not turn the crankshaft while Plastigage®is in place.
    c. Remove the cap. Using a Plastigage®scale, check the width of the Plastigage®at its widest point to get the minimum clearance. Check at its narrowest point to get the maximum clearance. The difference between the readings is the journal taper.
    d. If clearance exceeds the specified limits, try a 0.001 in. (0.0254mm) or 0.002 in. (0.051mm) undersize bearing in combination with the standard bearing. Bearing clearance must be within the specified limits. If a standard and 0.002 in. (0.051mm) undersize bearing do not bring clearance within the desired limits, refinish the crankshaft journal, then install undersize bearings.
5. Install all the bearing caps except the thrust bearing cap. Be sure the main bearing caps are installed in their original locations. Tighten the bearing cap bolts to specifications.
6. Install the thrust bearing cap with the bolts finger-tight.

➡Refer to Rear Main Oil Seal removal and installation for special instructions on applying RTV sealer to the rear main bearing cup.

7. Pry the crankshaft forward against the thrust surface of the upper half of the bearing.
8. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing.

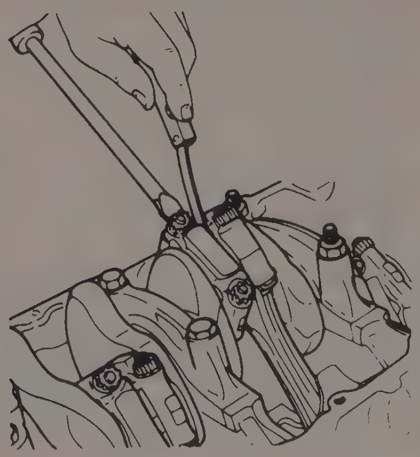


Fig. 215 Check the rod side clearance with a feeler gauge—use a small prybar to spread the rods

9. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications.

10. Check the crankshaft end-play using the following procedures:

a. Force the crankshaft toward the rear of the engine.

b. Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis.

c. Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.

d. If the end-play exceeds the wear limit listed in the Crankshaft and Connecting Rod Specifications chart, replace the thrust bearing. If the end-play is less than the minimum limit, inspect the thrust bearing faces fro scratches, burrs, nicks, or dirt. If the thrust faces are not damaged or dirty, then they probably were not aligned properly. Lubricate and install the new thrust bearing and align the faces.

11. On engines with one piece rear main bearing oil seal, coat a new crankshaft rear oil seal with oil and install using a seal driver.

12. Inspect the seal to be sure it was not damaged during installation.

13. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing.

14. After the connecting rod bearings have been fitted, apply a light coat of engine oil to the journals and bearings.

15. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.

16. Install the connecting rod cap. Tighten the nuts to specification.

17. After the piston and connecting rod assemblies have been installed, check the side clearance with a feeler gauge between the connecting rods on each connecting rod crankshaft journal. Refer to the Crankshaft and Connecting Rod specifications chart in this section.

18. Install the timing chain and sprockets or gears, cylinder front cover and crankshaft pulley and adapter, following steps under the cylinder front cover and timing chain installation procedure in this section

19. Re-grind the journals to give the proper clearance with the next undersize bearing. If the journal will not clean up to maximum undersize bearing available, replace the crankshaft.

20. Always reproduce the same journal shoulder radius that existed originally. Too small a radius will result in fatigue failure of the crankshaft. Too large a radius will result in bearing failure due to radius ride of the bearing.

21. After re-grinding the journals, chamfer the oil holes, then polish the journals with a #320 grit polishing cloth and engine oil. Crocus cloth may also be used as a polishing agent.

BEARING REPLACEMENT

▸ See Figures 216 thru 223

1. With the engine on a workstand, remove the front cover and timing gears. Remove the piston and rod assemblies. Identify each one for assembly.

2. Number and remove the main bearing caps. Remove the lower bearing inserts.

3. Use two of the main bearing cap bolts to wiggle the main caps loose, but be careful not to damage the bolt threads.

4. Lift out the crankshaft. Be sure to lift the crankshaft straight off the bearings to prevent damage to the thrust bearings.

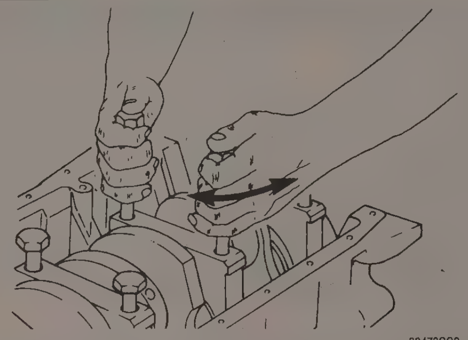


Fig. 216 Use two bearing cap bolts to loosen the caps—diesel engine

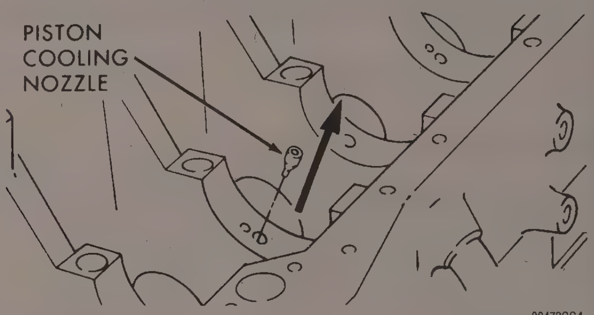


Fig. 217 Location of the piston cooling nozzles—diesel engine

5. Remove the upper bearing inserts.

6. Remove the diesel engine piston cooling nozzles by using a 3/18 in. (5mm) pin punch to push them out.

7. Support the crankshaft on V-blocks under Nos. 1 and 7 journals.

8. Mount a dial indicator contacting the center main bearing journal.

9. Rotate the crankshaft and note the reading. This is the crankshaft run-out.

10. Inspect all journals for wear, damage or overheating (blue color).

11. Check the clearance of each main bearing by placing a piece of Plastigage®or its equivalent, on bearing surface across full width of bearing cap and about ¼ in.(6mm) off center.

a. Install cap and tighten bolts to specifications. Do not turn crankshaft while Plastigage®is in place.

b. Remove the cap. Using Plastigage®scale, check width of Plastigage®at widest point to get the minimum clearance. Check at narrowest point to get maximum clearance. Difference between readings is taper of journal.

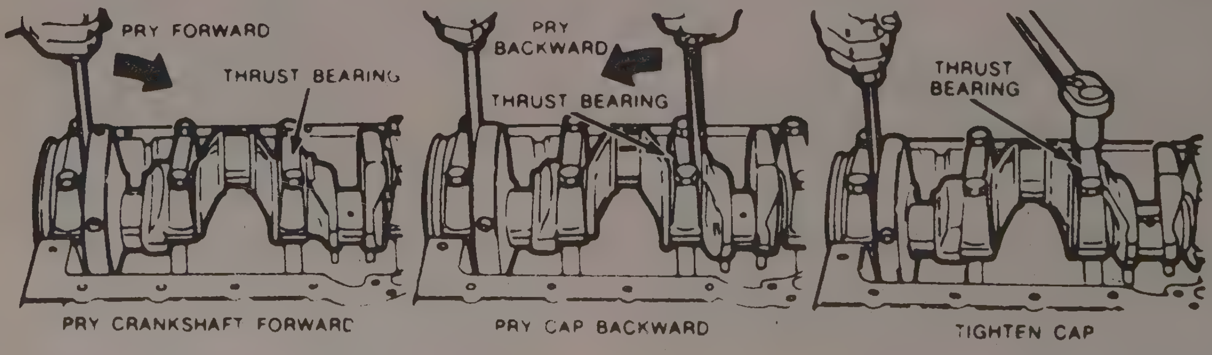


Fig. 218 Check the crankshaft thrust bearing alignment as shown

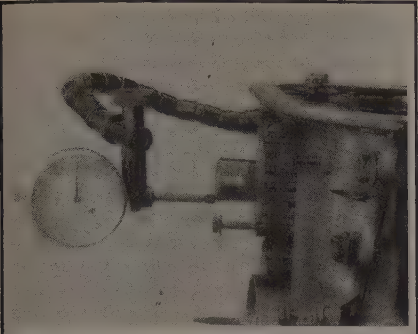

TCCS3805

Fig. 219 A dial gauge may be used to check crankshaft end-play

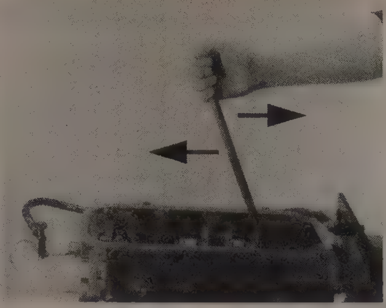

TCCS3806

Fig. 220 Carefully pry the crankshaft back and forth while reading the dial gauge for play

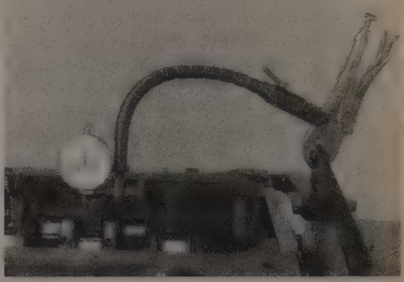

TCCS3807

Fig. 221 A dial gauge may also be used to check crankshaft run-out

c. If clearance exceeds specified limits, try a 0.001 in. (0.0254mm) or 0.002 in. (0.051mm) undersize bearing in combination with the standard bearing. Bearing clearance must be within specified limits. If standard and 0.002 in. (0.051mm) undersize bearing does not bring clearance within desired limits, refinish crankshaft journal, then install undersize bearings.

➡Refer to Rear Main Oil Seal removal and installation, for special instructions in applying RTV sealer to the rear main bearing cup.

12. Install all the bearing caps except the thrust bearing cap. Be sure the main bearing caps are installed in their original locations. Tighten the bearing cap bolts to specifications.
13. Install the thrust bearing cap with the bolts finger-tight.
14. Pry the crankshaft forward against the thrust surface of the upper half of the bearing.
15. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing.
16. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications.
17. Check the crankshaft end-play using the following procedures:
    a. Force the crankshaft toward the rear of the engine.
    b. Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis.
    c. Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.
    d. If the end-play exceeds the wear limit listed in the Crankshaft and Connecting Rod Specifications chart, replace the thrust bearing. If the end-play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or dirt. If the thrust faces are not damaged or dirty, then they probably were not aligned properly. Lubricate and install the new thrust bearing and align the faces following the procedure outlined earlier.
18. On engines with one piece rear main bearing oil seal, coat a new crankshaft rear oil seal with oil and install using a seal driver. Inspect the seal to be sure it was not damaged during installation.
19. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing, following the procedure (11a through 11d).
20. After the connecting rod bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
21. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.
22. Install the connecting rod cap. Tighten the nuts to specification.
23. After the piston and connecting rod assemblies have been installed,

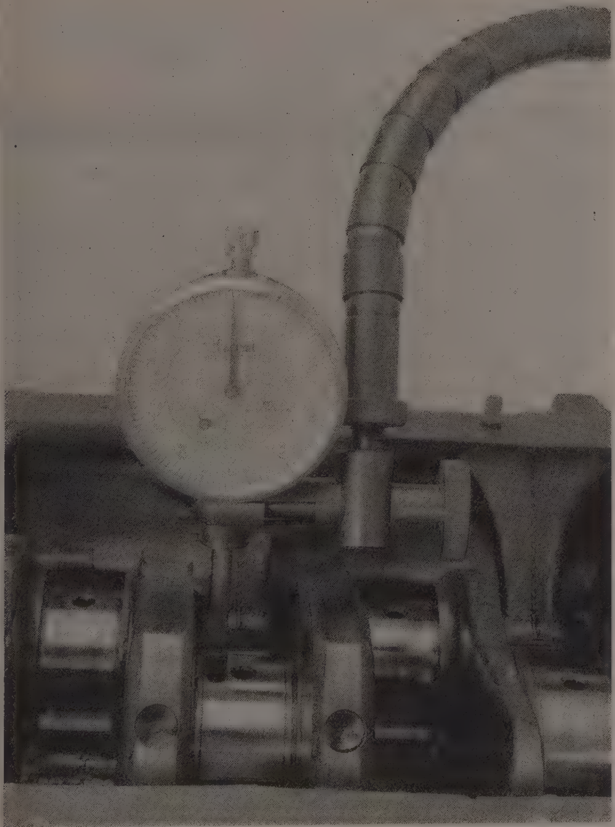

TCCS3815

Fig. 222 Mounting a dial gauge to read crankshaft run-out

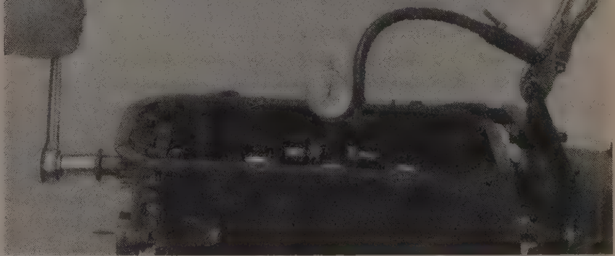

TCCS3808

Fig. 223 Turn the crankshaft slowly by hand while checking the gauge

check the side clearance with a feeler gauge between the connecting rods on each crankshaft journal. Refer to Crankshaft and Connecting Rod specifications chart in this section.

24. Install the timing chain, sprockets or gears, cylinder front cover and crankshaft pulley and adapter. Following the steps under Front Cover and Timing Chain Installation in this section.

COMPLETING THE REBUILDING PROCESS

Fill the oil pump with oil, to prevent cavitating (sucking air) on initial engine start up. Install the oil pump and the pickup tube on the engine. Coat the oil pan gasket as necessary, and install the gasket and the oil pan. Mount the flywheel and the crankshaft vibration damper or pulley on the crankshaft.

➡Always use new bolts when installing the flywheel. Inspect the clutch shaft pilot bushing in the crankshaft. If the bushing is excessively worn, remove it with an expanding puller and a slide hammer, and tap a new bushing into place.

Position the engine, cylinder head side up. Lubricate the lifters, and install them into their bores. Install the cylinder head, and tighten it to the specified torque figure. Insert the pushrods (where applicable), and install the rocker shaft(s), if so equipped or position the rockers.

Install the intake and exhaust manifolds, the throttle body, the distributor (if applicable) and spark plugs. Mount all accessories and install the engine in the truck. Fill the radiator with coolant, and the crankcase with high quality engine oil.

BREAK-IN PROCEDURE

Start the engine, and allow it to run at low speed for a few minutes, while checking for leaks. Stop the engine, check the oil level, and fill as necessary. Restart the engine, and top off the cooling system to capacity. Check and adjust the ignition timing. Run the engine at low to medium speed (800–2,500 rpm) for approximately ½ hour, and re-tighten the cylinder head bolts. Road test the truck, and check again for leaks.

➡Some gasket manufacturers recommend not re-tightening the cylinder head(s) due to the composition of the head gasket. Follow the directions in the gasket set.

Flywheel/Flexplate and Ring Gear

➡Flexplate is the term for a flywheel mated with an automatic transmission.

REMOVAL & INSTALLATION

▶ See Figure 224

➡The ring gear is replaceable only on engines mated with a manual transmission. Engines with automatic transmissions have ring gears which are welded to the flexplate.

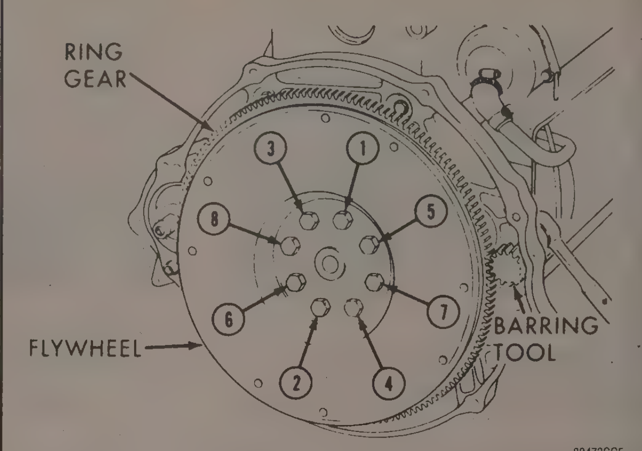


Fig. 224 Flywheel mounting bolt tightening sequence—diesel

1. Remove the transmission and transfer case.
2. Remove the clutch, if equipped, or torque converter from the flywheel. The flywheel bolts should be loosened a little at a time in a cross pattern to avoid warping the flywheel. On trucks with manual transmissions, replace the pilot bearing in the end of the crankshaft if removing the flywheel.
3. The flywheel should be checked for cracks and glazing. It can be resurfaced by a machine shop.
4. If the ring gear is to be replaced, drill a hole in the gear between two teeth, being careful not to contact the flywheel surface. Using a drift or a cold chisel, tap downward on the ring gear near welded areas to break any weld material. Tap around the ring gear until it comes off the torque converter.

To install:

5. Polish the inner surface of the new ring gear and heat it in an oven to about 200°F (93°C), allow to stay there for 15 to 20 minutes. Quickly place the ring gear on the flywheel and tap it into place, making sure that it is fully seated.

**** WARNING**

Never heat the ring gear past 800°F (426°C), or the tempering will be destroyed.

6. Reweld the ring gear to the torque converter front cover, being careful to place, as near as possible, the same amount of weld in the exact same places that were used in the original weld.
7. Position the flywheel on the end of the crankshaft. Tighten the bolts a little at a time, in a crisscross pattern, to the torque figure shown.
8. Install the clutch or torque converter. Install the transmission and transfer case.

EXHAUST SYSTEM

General Information

➡Safety glasses should be worn at all times when working on or near the exhaust system. Older exhaust systems will almost always be covered with loose rust particles which will shower you when disturbed. These particles are more than a nuisance; they could injure your eyes.

Whenever working on the exhaust system always keep the following in mind:

- Check the complete exhaust system for open seams, holes loose connections, or other deterioration which could permit exhaust fumes to seep into the passenger compartment.
- The exhaust system is usually supported by free-hanging rubber mountings which permit some movement of the exhaust system, but does not permit transfer of noise and vibration into the passenger compartment. Do not replace the rubber mounts with solid ones.
- Before removing any component of the exhaust system, ALWAYS squirt a liquid rust dissolving agent onto the fasteners for ease of removal. A lot of knuckle skin will be saved by following this rule. It may even be wise to spray the fasteners and allow them to sit overnight.

**** CAUTION**

Because many rust dissolving liquids are flammable, never use them on a hot exhaust system, or near an open flame.

- Annoying rattles and noise vibrations in the exhaust system are usually caused by misalignment of the parts. When aligning the system, leave all bolts and nuts loose until all parts are properly aligned, then tighten, working from front to rear.
- When installing exhaust system parts, make sure there is enough clearance between the hot exhaust parts and pipes and hoses that would be adversely affected by excessive heat. Also make sure there is adequate clearance from the floor pan to avoid possible overheating of the floor.

Safety Precautions

For a number of reasons, exhaust system work can be among the most dangerous type of work you can do on your truck. Always observe the following precautions:

- Support the truck extra securely. Not only will you often be working directly under it, but you'll frequently be using a lot of force, say, heavy hammer blows, to dislodge rusted parts. This can cause a truck that's improperly supported to shift and possibly fall.
- Wear goggles. Exhaust system parts are always rusty. Metal chips can be dislodged, even when you're only turning rusted bolts. Attempting to pry pipes apart with a chisel makes the chips fly even more frequently.
- If you're using a cutting torch, keep it a great distance from either the fuel tank or lines. Stop what you're doing and feel the temperature of the fuel bearing pipes on the tank frequently. Even slight heat can expand and/or vaporize fuel, resulting in accumulated vapor, or even a liquid leak, near your torch.
- Watch where your hammer blows fall and make sure you hit squarely. You could easily tap a brake or fuel line when you hit an exhaust system part with a glancing blow. Inspect all lines and hoses in the area where you've been working.

**** CAUTION**

Be very careful when working on or near the catalytic converter. External temperatures can reach 1,500°F (816°C) and more, causing severe burns. Removal or installation should be performed only on a cold exhaust system.

A number of special exhaust system tools can be rented from auto supply houses or local stores that rent special equipment. A common one is a tail pipe expander, designed to enable you to join pipes of identical diameter.

It may also be quite helpful to use solvents designed to loosen rusted bolts or flanges. Soaking rusted parts the night before you do the job can speed the work of freeing rusted parts considerably. Remember that these solvents are often flammable. Apply only to parts after they are cool!

COMPONENT REPLACEMENT

System components may be welded or clamped together. The system consists of a head pipe, catalytic converter, intermediate pipe, muffler and tail pipe, in that order from the engine to the back of the truck.

The head pipe is bolted to the exhaust manifold, on one end, and the catalytic converter on the other. Various hangers suspend the system from the floor pan. When assembling exhaust system parts, the relative clearances around all system parts is extremely critical. See the accompanying illustration and observe all clearances during assembly. In the event that the system is welded, the various parts will have to be cut apart for removal. In these cases, the cut parts may not be reused. To cut the parts, a hacksaw is the best choice. An oxy-acetylene cutting torch may be faster but the sparks are DANGEROUS near the fuel tank, and, at the very least, accidents could happen, resulting in damage to other under-truck parts, not to mention yourself!

The following replacement steps relate to clamped parts:

1. Raise and support the truck on jackstands. It's much easier on you if you can get the truck up on 4 jackstands. Some pipes need lots of clearance for removal and installation. If the system has been in the truck for a long time, spray the clamped joints with a rust dissolving solutions such as WD–40®or Liquid Wrench®, and let it set according to the instructions on the can.
2. Remove the nuts from the U-bolts; don't be surprised if the U-bolts break while removing the nuts. Age and rust account for this. Besides, you shouldn't reuse old U-bolts. When unbolting the headpipe from the exhaust manifold, make sure that the bolts are free before trying to remove them. If you snap a stud in the exhaust manifold, the stud will have to be removed with a bolt extractor, which often necessitates the removal of the manifold itself.
3. After the clamps are removed from the joints, first twist the parts at the joints to break loose rust and scale, then pull the components apart with a twisting motion. If the parts twist freely but won't pull apart, check the joint. The clamp may have been installed so tightly that it has caused a slight crushing of the joint. In this event, the best thing to do is secure a chisel designed for the purpose and, using the chisel and a hammer, peel back the female pipe end until the parts are freed.
4. Once the parts are freed, check the condition of the pipes which you had intended keeping. If their condition is at all in doubt, replace them too. You went to a lot of work to get one or more components out. You don't want to have to go through that again in the near future. If you are retaining a pipe, check the pipe end. If it was crushed by a clamp, it can be restored to its original diameter using a pipe expander, which can be rented at many good auto parts stores. Check, also, the condition of the exhaust system hangers. If ANY deterioration is noted, replace them. Oh, and one note about parts: use only parts designed for your truck. Don't use fits-all parts or flex pipes. The fits-all parts rarely fit like originals and the flex pipes don't last very long.
5. When installing the new parts, coat the pipe ends with exhaust system lubricant. It makes fitting the parts much easier. It's also a good idea to assemble all the parts in position before clamping them. This will ensure a good fit, detect any problems and allow you to check all clearances between the parts and surrounding frame and floor members.
6. When you are satisfied with all fits and clearances, install the clamps. The headpipe-to-manifold nuts should be torqued to 20 ft. lbs. (27 Nm). If the studs were rusty, wire-brush them clean and spray them with WD–40®or Liquid Wrench®. This will ensure a proper torque reading. Position the clamps on the slip points as illustrated. The slits in the female pipe ends should be under the U-bolts, not under the clamp end. Tighten the U-bolt nuts securely, without crushing the pipe. The pipe fit should be tight, so that you can't swivel the pipe by hand. Don't forget: always use new clamps. When the system is tight, recheck all clearances. Start the engine and check the joints for leaks. A leak can be felt by hand.

**** CAUTION**

MAKE CERTAIN THAT THE TRUCK IS SECURE BEFORE GETTING UNDER IT WITH THE ENGINE RUNNING!!

7. If any leaks are detected, tighten the clamp until the leak stops. If the pipe starts to deform before the leak stops, reposition the clamp and tighten it. If that still doesn't stop the leak, it may be that you don't have enough overlap on the pipe fit. Shut off the engine and try pushing the pipe together further. Be careful; the pipe gets hot quickly.
8. When everything is tight and secure, lower the truck and take it for a road test. Make sure there are no unusual sounds or vibration. Most new pipes are coated with a preservative, so the system will be pretty smelly for a day or two while the coating burns off.

Muffler and Outlet Pipes

REMOVAL & INSTALLATION

▸ See Figure 225

➡The following applies to exhaust systems using clamped joints. Some models, use welded joints at the muffler. These joints will have to be cut. Always use new gaskets during installation. It is also wise to purchase new clamps or hangers

1. Raise and support the truck on jackstands.
2. Remove the U-clamps securing the muffler and outlet pipe.
3. Disconnect the muffler and outlet pipe bracket and insulator assemblies.
4. Remove the muffler and outlet pipe assembly. It may be necessary to heat the joints to get the parts to come off. Special tools are available to aid in breaking loose the joints. Discard any old exhaust pipes, or mufflers, along with any clamps or rusty nuts and bolts that are not usable again.
5. On Crew Cab models, remove the extension pipe.

➡For rod and insulator type hangers, apply a soap solution to the insulator surface and rod ends to allow easier removal of the insulator from the rod end. Don't use oil-based or silicone-based solutions since they will allow the insulator to slip back off once it's installed.

To install:

6. Assemble the muffler and rear exhaust pipes together, along with supports and clamps before installing.
7. Install the components making sure that all the components in the system are properly aligned before tightening any fasteners. Make sure all tabs are indexed and all parts are clear of surrounding body panels.

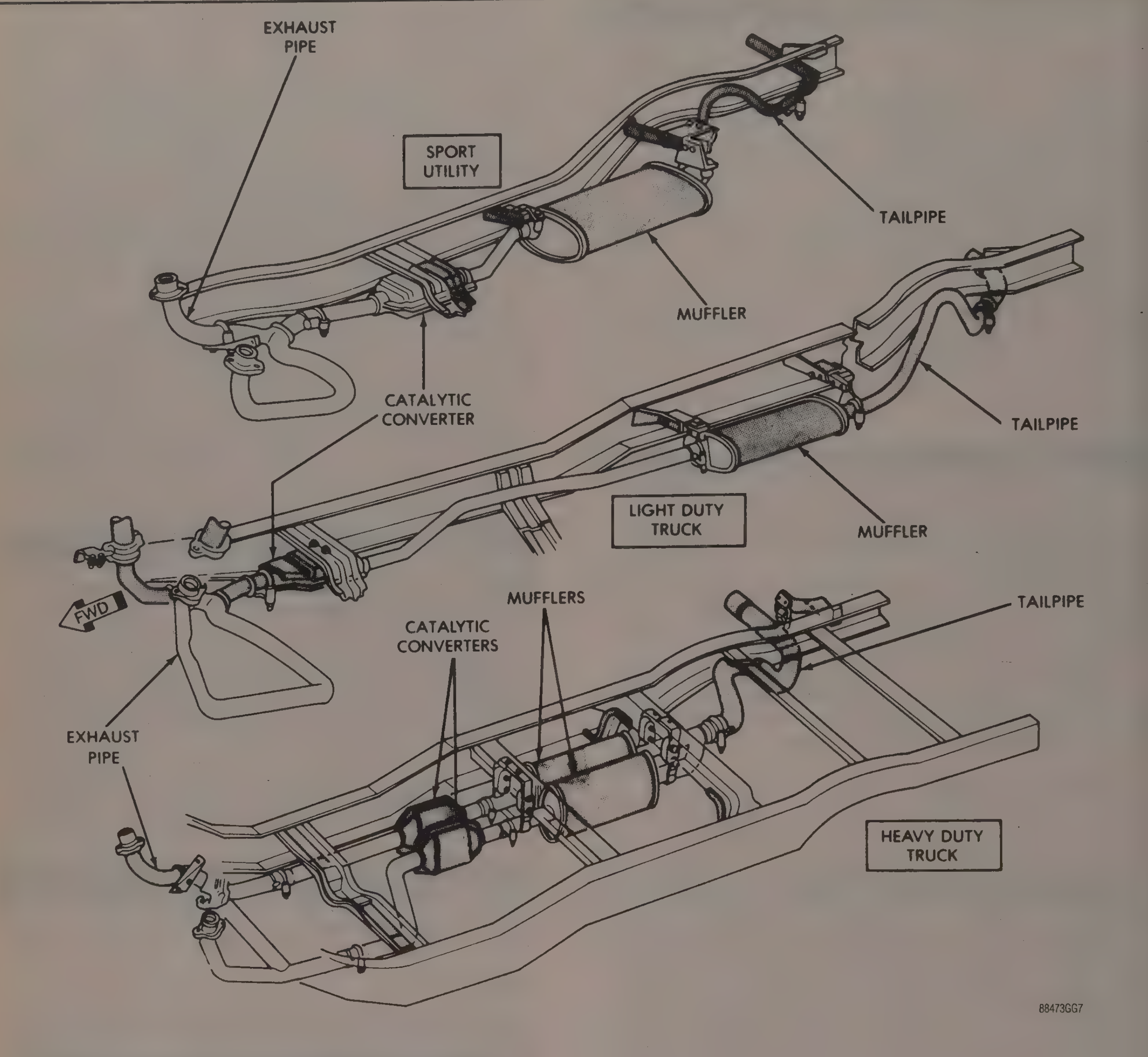


Fig. 225 Common Dodge truck exhaust systems—full-size trucks

Front Header Pipes, Catalytic Converter and Inlet Pipes

REMOVAL & INSTALLATION

▸ See Figure 225

➡The following applies to exhaust systems using clamped joints. Some models, use welded joints at the muffler. These joints will have to be cut. Always use new gaskets during installation. It is also wise to purchase new clamps or hangers.

1. Raise and support the truck on jackstands.
2. Disconnect the front exhaust pipe flange or flanges for V engines, nuts and bolts connected to the exhaust manifold.
3. Loosen and remove any bolts to the catalytic converter (if equipped), or the flange prior to the muffler. If your system has no flanges all the way to the end of the exhaust, you will either have to cut the exhaust where you are replacing the piece, or replace the unit as an assembly.
4. Most aftermarket parts suppliers have your exhaust in cut sections, (unlike your original exhaust). It is wise to look at your exhaust before cutting any pipe if you are not purchasing your exhaust parts from the dealer.
5. Remove the pipe assembly. It may be necessary to heat the joints to separate the parts. Special tools are available to aid in breaking loose the joints. Discard any old pipes, and any clamps or rusty nuts and bolts.

➡For rod and insulator type hangers, apply a soap solution to the insulator surface and rod ends to allow easier removal of the insulator from the rod end. Don't use oil-based or silicone-based solutions since they will allow the insulator to slip back off once it's installed.

To install:

6. Install the front header pipe with new exhaust nuts and gaskets. Attach the catalytic converter (if equipped) at the flange of the header pipe and tighten. Install any rear exhaust pipes together, along with supports and clamps.
7. Make sure that all the system components are properly aligned before tightening fasteners. Make sure all tabs are indexed and all parts are clear of surrounding body panels.

1989-93 2.5L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Cylinder Block		
Deck height:	9.32	236.73
Deck clearance:	0	0
Cylinder bore		
Standard size:	3.445	87.5
Maximum out-of-round:	0.002	0.05
Maximum taper:	0.005	0.125
Cylinder Head		
Compression pressure:	100 psi	689 kPa
Maximum variation between cylinders: 25 percent		
Gasket thickness (compressed):	0.068	1.73
Flatness of gasket surface:	0.004	0.1
Valves		
Dimensions		
Intake		
Head thickness (margin)	0.06	1.5
Minimum:	0.031	0.794
Stem diameter:	0.3124	7.935
Face angle: 45 degrees		
Valve margin	0.031	0.794
Head diameter:	1.6	40.6
Length (overall)	4.498	114.87
Stem-to-guide clearance:	0.0009-0.0026	0.022-0.065
Exhaust		
Head thickness (margin):	0.06	1.5
Minimum:	0.047	1.191
Length	0.3103	7.881
Stem diameter:	0.0469	1.191
Face angle: 44.5 degrees	1.39	35.4
Valve margin	4.522	114.87
Head diameter:	1.39	35.4
Length (overall)	4.522	114.87
Stem-to-guide clearance:	0.0030-0.0047	0.076-0.119
Valve seat angle: 45 degrees		
Valve guide head bore diameter		
Intake (max reading):	0.02	0.5
Exhaust: (max. reading)	0.027	0.7
Valve guide reamer		
Oversize 1/valve guide size	0.005/0.3198-0.3208	0.15/8.125-8.150
Oversize 2/valve guide size	0.015/0.3297-0.3307	0.40/8.375-8.4
Oversize 3/valve guide size	0.03/0.3454-0.3464	0.8/8.775-8.8
Valve lash		
Dry: ②	0.024-0.060	0.62-1.52
Valve Springs		
Installed height:	1.62-1.68	41.2-42.7
Free length (approx):	2.16	54.9
Spring tension		
Valve closed:	107-120 lbs. @ 1.65 in.	480-534 N @ 41.91mm
Valve open:	221-235 lbs. @ 1.22 in.	890-961 N @ 30.99mm
Valve spring perpendicularity:	0.079	2
Valve Timing		
Intake valve		
Closes (ABDC): 60 degrees		
Opens (ATDC): 4 degrees		
Duration: 236 degrees		
Exhaust valve		
Closes (ATDC): 12 degrees		
Opens (ATDC): 40 degrees		
Duration: 232 degrees		
Valve overlap: 8 degrees		
Crankshaft		
Crankshaft main bearing clearance:	0.0004-0.0028	0.011-0.072
Crankshaft con rod bearing clearance:	0.0007-0.0029	0.019-0.075
Crankshaft end-play		
New part:	0.002-0.007	0.05-0.018
Wear limit:	0.15	0.37

88473C22

1989-93 2.5L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Connecting Rods		
Bearing clearance:	0.0008-0.0034	0.019-0.087
Maximum:	0.0042	0.107
Side clearance:	0.005-0.013	0.13-0.32
Parallelism and twist:	0.003	0.08
Pistons		
Outside diameter:	3.443-3.444	87.455-87.468
Ring side clearance		
No. 1 ring:	0.0015-0.0031	0.038-0.078
Service limit:	0.004	0.1
No. 2 ring:	0.0015-0.0037	0.038-0.093
Service limit:	0.004	0.1
Piston ring end-gap		
No. 1 ring:	0.010-0.020	0.25-0.51
Service limit:	0.039	1
No. 2 ring:	0.011-0.021	0.23-0.48
Service limit:	0.039	1
Oil ring side rail:	0.015-0.055	0.38-1.40
Service limit:	0.074	1.88
Camshaft		
Journal diameter:	1.375-1.376	34.939-34.960
Oversize journal diameter:	1.395-1.396	35.439-35.460
Lobe wear (service limit):	0.01	0.25
End-play:	0.005-0.013	0.13-0.33
Max 9	0.02	0.5
Intermediate Shaft		
Journal		
Large:	1.68-1.681	42.67-42.695
Small:	0.774-0.775	19.670-19.695
Bushing inside diameter		
Large:	1.682-1.683	42.730-42.750
Small:	0.776-0.778	19.720-19.75
Oil Pump		
Relief valve opening pressure:	60 psi	414 kPa
Maximum:	80 psi	550 kPa
Relief spring free length:	1.95	49.5
Relief spring load:	19.5-20.5 @ 1.34 kPa	86-91 N @ 34mm
Minimum:	18.5 lbs. @ 1.34 in.	82 N @ 34mm
Cover flatness:	0.002	0.05
Maximum:	0.003	0.076
Inner and outer rotor		
Housing clearance:	0.001-0.003	0.03-0.08
Maximum	0.0035	0.09
Thickness:	0.944-0.945	23.97-24.00
Minimum:	0.9435	23.96
Tip clearance between rotors:	0.001-0.006	0.03-0.15
Maximum:	0.008	0.2
Outer rotor housing bore clearance:	0.01	0.25
Maximum:	0.014	0.35
Oil Pressure		
Pressure at curb idle: ③	4 psi	30 kPa
Pressure at 3000 rpm:	25-80 psi	170-550 kPa
Oil pressure switch		
Actuating pressure (min):	2-4 psi	14-28 kPa

① Unless otherwise specified with a different measurement standard (for example, psi, kPa, lbs., N, etc.), this will be the measurement standard implied for all figures provided in this column

② Dry lash is the amount of clearance existing between the base circle of an installed cam and the rocker arm roller when the adjuster is drained of oil

③ If oil pressure is 0 at idle, do not run it at 3000 rpm

88473C23

1994-96 2.5L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Cylinder Block		
Deck height:	9.32	236.73
Deck clearance:	0	0
Cylinder bore		
Standard size:	3.445	87.5
Maximum out-of-round:	0.002	0.05
Maximum taper:	0.005	0.125
Cylinder Head		
Compression pressure:	100 psi	689 kPa
Gasket thickness (compressed):	0.068	1.73
Flatness of gasket surface:	0.004	0.1
Valves		
Dimensions		
Intake		
Head thickness (margin)	0.06	1.5
Minimum:	0.031	0.794
Stem diameter:	0.3124	7.935
Face angle: 45 degrees		
Valve margin	0.031	0.794
Head diameter:	1.6	40.6
Length (overall)	4.498	114.87
Stem-to-guide clearance:	0.0009-0.0026	0.022-0.065
Exhaust		
Head thickness (margin):	0.06	1.5
Minimum:	0.047	1.191
Length	0.3103	7.881
Stem diameter:	0.0469	1.191
Face angle: 44.5 degrees	1.39	35.4
Valve margin	4.522	114.87
Head diameter:	1.39	35.4
Length (overall)	4.522	114.87
Stem-to-guide clearance:	0.0030-0.0047	0.076-0.119
Valve seat angle: 45 degrees		
Valve guide head bore diameter		
Intake (max reading):	0.02	0.5
Exhaust: (max. reading)	0.027	0.7
Valve guide reamer		
Oversize 1/valve guide size	0.005/0.3198-0.3208	0.15/8.125-8.150
Oversize 2/valve guide size	0.015/0.3297-0.3307	0.40/8.375-8.4
Oversize 3/valve guide size	0.03/0.3454-0.3464	0.8/8.775-8.8
Valve lash		
Dry: ②	0.024-0.060	0.62-1.52
Valve Springs		
Installed height:	1.62-1.68	41.2-42.7
Free length (approx):	2.16	54.9
Spring tension		
Valve closed:	107-120 lbs. @ 1.65 in.	480-534 N @ 41.91mm
Valve open:	221-235 lbs. @ 1.22 in.	890-961 N @ 30.99mm
Valve spring perpendicularity:	0.079	2
Valve Timing		
Intake valve		
Closes (ABDC): 60 degrees		
Opens (ATDC): 4 degrees		
Duration: 236 degrees		
Exhaust valve		
Closes (ATDC): 12 degrees		
Opens (ATDC): 40 degrees		
Duration: 232 degrees		
Valve overlap: 8 degrees		
Crankshaft		
Crankshaft main bearing clearance:	0.0004-0.0028	0.011-0.072
Crankshaft con rod bearing clearance:	0.0007-0.0029	0.019-0.075
Crankshaft end-play		
New part:	0.002-0.007	0.05-0.018
Wear limit:	0.15	0.37

88473C24

1994-96 2.5L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Connecting Rods		
Bearing clearance:	0.0008-0.0034	0.019-0.087
Maximum:	0.0042	0.107
Side clearance:	0.005-0.013	0.13-0.32
Parallelism and twist:	0.003	0.08
Pistons		
Outside diameter:	3.443-3.446	87.455-87.520
Rail side clearance		
No. 1:	0.0015-0.0031	0.038-0.078
Maximum gap:	0.004	0.1
No. 2:	0.0015-0.0031	0.038-0.078
Maximum gap:	0.004	0.1
Piston Rings		
Top compression		
End clearance:	0.0090-0.0240	0.2286-0.6096
Side clearance:	0.0017-0.0033	0.04318-0.08382
Bottom compression		
End clearance:	0.0190-0.0380	0.4826-0.9652
Side clearance:	0.0017-0.0033	.04318-0.08382
Oil control		
End clearance:	0.010-0.060	0.254-1.524
Side clearance (max):	0.0024-0.0083	0.06096-0.2116
Camshaft		
Journal diameter:	1.375-1.376	34.939-34.960
Oversize journal diameter:	1.395-1.396	35.439-35.460
Lobe wear	0.01	0.25
Lobe lift		
Exhaust:	0.259	6.579
Intake:	0.255	6.477
End-play:	0.005-0.013	0.13-0.33
Maximum	0.02	0.5
Intermediate Shaft		
Journal		
Large:	1.68-1.681	42.67-42.695
Small:	0.774-0.775	19.670-19.695
Bushing inside diameter		
Large:	1.682-1.683	42.730-42.750
Small:	0.776-0.778	19.720-19.75
Oil Pump		
Relief valve opening pressure:	60 psi	414 kPa
Maximum:	80 psi	550 kPa
Relief spring free length:	1.95	49.5
Relief spring load:	19.5-20.5 @ 1.34 kPa	86-91 N @ 34mm
Minimum:	18.5 lbs. @ 1.34 in.	82 N @ 34mm
Cover flatness:	0.002	0.05
Maximum:	0.003	0.076
Inner and outer rotor		
Housing clearance:	0.001-0.003	0.03-0.08
Maximum	0.0035	0.09
Thickness:	0.944-0.945	23.97-24.00
Minimum:	0.9435	23.96
Tip clearance between rotors:	0.001-0.006	0.03-0.15
Maximum:	0.008	0.2
Outer rotor housing bore clearance:	0.01	0.25
Maximum:	0.014	0.35
Oil Pressure		
Pressure at curb idle: ③	4 psi	30 kPa
Pressure at 3000 rpm:	25-80 psi	170-550 kPa
Oil pressure switch		
Actuating pressure (min):	2-4 psi	14-28 kPa

① Unless otherwise specified with a different measurement standard (for example, psi, kPa, lbs., N, etc.), this will be the measurement standard implied for all figures provided in this column

② Dry lash is the amount of clearance existing between the base circle of an installed cam and the rocker arm roller when the adjuster is drained of oil

③ If oil pressure is 0 at idle, do not run it at 3000 rpm

88473C25

1989-96 3.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Cylinder Block		
Cylinder bore		
Standard size:	3.91-3.912	99.314-99.365
Maximum out-of-round:	0.005	0.127
Maximum taper:	0.01	0.254
Maximum oversize:	0.04	1.016
Distributor lower driveshaft		
Bushing (press fit in block)	0.0005-0.0140	0.0127-0.3556
Shaft-to bushing clearance:	0.0007-0.0027	0.0178-0.0686
Tappet bore diameter:	0.9051-0.9059	22.99-23.01
Cylinder Head		
Compression pressure:	100 psi	689 kPa
Gasket thickness (compressed):	0.0475	1.2065
Valve seat		
Angle: 44.25-44.75 degrees ②		
Maximum runout:	0.003	0.0762
Width (finish)-intake:	0.04-0.06	1.016-1.542
Width (finish)-exhaust:	0.06-0.08	1.524-2.032
Hydraulic Lifters		
Body diameter:	0.9035-0.9040	22.949-22.962
Clearance in block:	0.0011-0.0024	0.0279-0.0610
Dry lash: ③	0.060-0.210	1.524-5.334
Pushrod length:	6.915-6.935	175.64-176.15
Valves		
Dimensions		
Face angle: 43.25-43.75		
Stem diameter:	0.311-0.312	7.899-7.925
Head diameter		
Intake:	1.916	48.666
Exhaust:	1.624	41.25
Length (overall)		
Intake:	4.893-4.918	124.28-125.92
Exhaust:	4.907-4.932	124.64-125.27
Stem-to-guide clearance:	0.001-0.003	0.0254-0.0762
Maximum allowable (rocking method):	0.017	0.4318
Valve guide head bore diameter (std.)	0.313-0.314	7.950-7.976
Valve guide reamer		
Oversize 1/valve guide size	0.003/0.316-0.317	0.076/8.026-8.052
Oversize 2/valve guide size	0.015/0.328-0.329	0.381/8.331-8.357
Lift (zero lash):	0.432	10.973
Valve Springs		
Installed height (spring seat to retainer):	1.64	41.66
Free length (approx.):	1.967	49.962
Spring tension		
Valve closed:	85 lbs. @ 1.64 in.	378 N @ 41.66mm
Valve open:	200 lbs. @ 1.212 in.	890 N @ 30.89mm
Number of coils: 6.8		
Wire diameter:	0.177	4.5
Valve Timing		
Intake valve		
Closes (ATC): 25 degrees		
Opens (BBC): 56 degrees		
Duration: 264 degrees		
Exhaust valve		
Closes (ABC): 65 degrees		
Opens (BTC): 8 degrees		
Duration: 250 degrees		
Valve overlap: 31 degrees		

88473C26

1989-96 3.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Crankshaft		
Connecting rod journals		
Diameter:	2.124-2.125	53.950-53.975
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Diametrical clearance:		
No. 1:	0.0005-0.0015	0.013-0.038
Nos. 2, 3 and 4:	0.0005-0.0020	0.013-0.051
Maximum allowable (Nos. 2, 3 and 4):	0.0025	0.064
Crankshaft end-play		
New part:	0.002-0.007	0.05-0.0178
Wear limit:	0.001	0.254
Main bearing journals		
Diameter:	2.4995-2.5005	63.487-63.513
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Connecting Rods		
Bearing clearance:	0.0005-0.0022	0.013-0.056
Maximum:	0.003	0.08
Piston pin bore diameter:	0.9829-0.9834	24.940-24.978
Side clearance:	0.006-0.014	0.152-0.356
Total weight (less bearing):	25.61 oz.	726 grams
Pistons		
Clearance at top of skirt:	0.0005-0.0015	0.0127-0.0381
Land clearance (diametrical):	0.025-0.040	0.635-1.016
Piston length:	3.4	86.36
Piston ring groove depth		
Nos. 1 and 2:	0.180-0.190	4.572-4.826
No. 3:	0.150-0.160	3.810-4.064
Weight:	20.9-21.04 oz.	592.6-596.6 grams
Piston Pins:		
Clearance:		
In piston:	0.00025-0.00075	0.00635-0.01905
In rod (interference):	0.0007-0.0014	0.0178-0.0356
Diameter:	0.9841-0.9843	24.996-25.001
End-play:	0	0
Length:	2.990-3.010	75.946-76.454
Piston Rings		
Top compression		
End clearance:	0.010-0.020	0.254-0.508
Side clearance:	0.0015-0.0030	0.038-0.076
Ring width:	0.0776-0.0783	1.971-1.989
Bottom compression		
End clearance:	0.020-0.030	0.508-0.762
Side clearance:	0.0015-0.0030	0.038-0.076
Ring width:	0.0776-0.0783	1.971-1.989
Oil control		
End clearance:	0.010-0.050	0.254-1.270
Side clearance:	0.002-0.008	0.06-0.21
Ring width:	0.0776-0.0783	1.971-1.989
Camshaft		
Bearing diameter		
No. 1:	2.000-2.001	50.800-50.825
No. 2:	1.984-1.985	50.394-50.419
No. 3:	1.953-1.954	49.606-49.632
No. 4:	1.5625-1.5635	39.688-39.713
Diametrical clearance:	0.001-0.003	0.0254-0.0762
Max. allowable:	0.005	0.127
End-play:	0.002-0.010	0.051-0.254
Bearing journal diameter		
No. 1:	1.998-1.999	50.749-50.775
No. 2:	1.982-1.983	50.343-50.368
No. 3:	1.951-1.952	49.555-49.581
No. 4:	1.5605-1.5615	39.637-39.662

88473C27

1989-96 3.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Oil Pump		
Clearance over rotors (max.):	0.1016	0.004
Cover out-of-flat (max.):	0.0015	0.0381
Inner rotor thickness (min.):	0.825	20.955
Outer rotor		
Clearance (max.):	0.014	0.3556
Diameter (min.):	2.469	62.7126
Thickness (min.):	0.825	20.955
Tip clearance between rotors (max.).	0.008	0.2032
Oil Pressure		
Pressure at curb idle (min.): ④	6 psi	41.4 kPa
Pressure at 3000 rpm:	30-80 psi	207-552 kPa
Oil pressure switch		
Actuating pressure (min):	5-7 psi	34-48.3 kPa
Oil Filter		
Bypass valve setting:	9-15 psi	62-103 kPa

① Unless otherwise specified with a different measurement standard (for example, psi, kPa, lbs., N, etc.), this will be the measurement standard implied for all figures provided in this column

② For 1989-93 models, valve seat angle is 45-45.5 degrees.

③ Dry lash is the amount of clearance existing between the base circle of an installed cam and the rocker arm roller when the adjuster is drained of oil

④ If oil pressure is 0 at idle, do not run it at 3000 rpm

88473C28

1989-93 5.2L AND 5.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Cylinder Block		
Cylinder bore		
Standard size:		
5.2L:	3.910-3.912	99.31-99.36
5.9L:	4.000-4.002	101.60-101.65
Maximum out-of-round:	0.005	0.127
Maximum taper:	0.01	0.254
Maximum oversize:	0.04	1.016
Distributor lower driveshaft		
Bushing (press fit in block)	0.0005-0.0140	0.127-0.3556
Shaft-to bushing clearance:	0.0007-0.0027	0.0178-0.0686
Tappet bore diameter:	0.9051-0.9059	22.99-23.01
Cylinder Head		
Compression pressure:	100 psi	689 kPa
Gasket thickness (compressed):	0.033	0.8382
Valve seat (intake and exhaust)		
Angle: 45 - 45 1/2 degrees		
Maximum runout:	0.003	0.0762
Width (finish)-intake:	0.065-0.085	1.651-2.159
Width (finish)-exhaust:	0.080-0.100	2.032-2.540
Hydraulic Lifters		
Body diameter:	0.9035-0.9040	22.949-22.962
Clearance in block:	0.0011-0.0024	0.0279-0.0610
Dry lash: ②	0.060-0.210	1.524-5.334
Pushrod length		
5.2L:	6.794-6.814	172.57-173.08
5.9L:	7.505-7.525	190.63-191.14
Valves		
Intake		
Head diameter		
5.2L.	1.78	45.212
5.9L:	1.88	47.752
Length overall		
5.2L:	4.962-4.987	126.03-126.67
5.9L:	4.969-4.994	126.21-126.85
Stem diameter (standard):	0.372-0.373	9.449-9.474
Stem-to-guide clearance:	0.001-0.003	0.0254-0.0762
Maximum clearance (rocking method):	0.017	0.4318
Face angle: 44 1/2 - 45 degrees		
Lift (zero lash)		
5.2L:	0.4	10.16
5.9L:	0.41	10.414
Valves for service		
Oversize 1:	0.005	0.127
Oversize 2:	0.0015	0.381
Oversize 3:	0.03	0.762
Exhaust		
Head diameter		
5.2L:	1.517	
5.9L:	1.617	
Length overall		
Without rotators (5.2L):	4.969-5.005	126.21-127.13
With rotators (5.2L):	4.977-5.012	126.42-127.30
5.9L:	4.978-5.012	126.44-127.30
Stem diameter (standard):	0.371-0.372	9.423-9.449
Stem-to-guide clearance:	0.002-0.004	0.0508-0.1016
Maximum clearance (rocking method):	0.017	0.4318
Face angle: 44 1/2 - 45 degrees		
Lift (zero lash)		
5.2L:	0.4	10.16
5.9L:	0.41	10.414
Valves for service		
Oversize 1:	0.005	0.127
Oversize 2:	0.0015	0.381
Oversize 3:	0.03	0.762

88473C29

1989-93 5.2L AND 5.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Valve springs		
Free length (approx.):		
Intake:	2	49.962
Exhaust:	1.81	45.97
Load when compressed (valve closed)		
Intake:	78-88 lbs. @ 1 11/16 in.	347-391 N @ 42.86mm
Exhaust:	80-90 lbs. @ 1 31/64 in.	356-400 N @ 37.70mm
Load when compressed (valve open)		
Intake:	170-184 lbs. @ 1 5/16 in.	756-818 N @ 33.34mm
Exhaust:		
5.2L:	180-194- @ 1 5/64 in.	801-876 N @ 27.38mm
5.9L:	181-197 lbs. @ 1 1/16 in.	805-876 N @ 26.99mm
Maximum allowable out-of-plumb:	1/16 in.	1.588mm
Valve spring installed height (seat-to-retainer) ③		
Intake:	1 5/8 - 1 11/16 in.	41.275-42.86mm
Exhaust:	1 29/64 - 1 33/64 in.	36.909-38.497
Wire diameter:	0.192	4.877
Number of coils: 6.79		
Intake:6.4		
Exhaust (with rotators)		
5.2L: 5.8		
5.9L: 5.6		
Valve timing		
Intake valve		
Opens (BTC): 18 degrees		
Closes (ABC): 54 degrees		
Valve duration: 252 degrees		
Exhaust valve		
Opens (BBC): 57 degrees		
Closes (ATC): 15 degrees		
Valve duration: 252 degrees		
Valve overlap: 33 degrees		
Crankshaft		
Connecting rod journals		
Diameter:	2.124-2.125	53.950-53.975
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Main bearing diametrical clearance:		
No. 1:	0.0005-0.0015	0.0127-0.0381
Maximum allowable:	0.0015	0.0381
Nos. 2-5:	0.0005-0.0015	0.0127-0.0381
Maximum:	0.0025	0.0635
End-play		
5.2L:	0.002-0.007	0.051-0.178
5.9L:	0.002-0.009	0.051-0.229
Maximum allowable:	0.01	0.254
Main bearing journals		
Diameter:		
5.2L:	2.4995-2.5005	63.487-63.513
5.9L:	2.8095-2.8105	71.361-71.387
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Bearings for service		
1st oversize:	0.001	0.0254
2nd oversize:	0.002	0.0508
3rd oversize:	0.003	0.0762
4th oversize:	0.01	0.254
5th oversize	0.012	0.3048
Connecting rods		
Length (center-to-center):	6.121	155.473
Piston pin bore diameter:	0.9829-0.9834	24.940-24.978
Side clearance (two rods):	0.006-0.014	0.152-0.356
Total weight (less bearing shells):		
5.2L:	25.61 oz.	726 grams
5.9L:	26.74 oz.	758 grams

88473C30

1989-93 5.2L AND 5.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Pistons		
Land clearance (diameter):		
5.2L:	0.019-0.024	0.483-0.610
5.9L:	0.508-0.660	0.020-0.026
Piston length (overall)		
5.2L:	3.4	86.36
5.9L:	3.19	81.03
Ring groove depth (5.2L)		
No. 1:	0.205	5.207
No. 2:	0.205	5.207
No. 3:	0.194	4.928
Weight:	20.90-21.04 oz.	592.6-596.6 grams
Ring groove depth (5.9L)		
No. 1:	0.21	5.334
No. 2:	0.21	5.334
No. 3:	0.199	5.055
Weight:	20.52-20.82 oz.	582-586 grams
Piston pins:		
Type: Press fit in rod		
Diameter:	0.9841-0.9843	24.996-25.001
Length:	2.990-3.020	75.946-76.708
Clearance:		
In piston		
5.2L:	0.0000-0.0005	0.0000-0.0127
5.9L (light thumb push):	0.00025-0.00075	0.0064-0.0191
In rod (interference):	0.0007-0.0014	0.0178-0.0356
Pins for service: Standard		
Oversize:	0.003-0.008	0.076-0.203
End-play:	0	0
Piston rings		
Ring width:		
Compression:	0.077-0.078	1.9558-1.9812
Oil ring (steel rails):	0.0252 (max)	0.640 (max.)
Ring gap		
Compression:	0.010-0.020	0.254-0.508
Oil ring (steel rails):	0.015-0.055	0.381-1.397
Ring side clearance		
Compression:	0.0015-0.003	0.038–.076
Oil ring (steel rails):	0.0002-0.0050	0.005-0.127
Ring gap (service rings)		
Compression:	0.010-0.020	0.254-1.508
Oil ring (steel rails):		
5.2L:	0.010-0.062	0.254-1.575
5.9L:	0.015-0.062	0.381-1.575
Ring side clearance		
Compression:	0.0015-0.004	0.038-0.102
Oil ring (steel rails):	0.0002-0.005	0.005-0.127
Camshaft		
Bearing diameter		
No. 1:	2.000-2.001	50.800-50.825
No. 2:	1.984-1.985	50.394-50.419
No. 3:	1.953-1.954	49.606-49.632
No. 4:	1.5625-1.5635	39.688-39.713
Diametrical clearance:	0.001-0.003	0.0254-0.0762
Max. allowable:	0.005	0.127
Thrust taken by: thrust plate		
End-play:	0.002-0.010	0.051-0.254
Bearing journal diameter		
No. 1:	1.998-1.999	50.749-50.775
No. 2:	1.982-1.983	50.343-50.368
No. 3:	1.951-1.952	49.555-49.581
No. 4:	1.5605-1.5615	39.637-39.662

88473C31

1989-93 5.2L AND 5.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Oil pump		
Clearance over rotors (max.):	0.1016	0.004
Cover out-of-flat (max.):	0.0015	0.0381
Inner rotor thickness (min.):	0.825	20.955
Outer rotor		
Clearance (max.):	0.014	0.3556
Diameter (min.):	2.469	62.7126
Thickness (min.):	0.825	20.955
Tip clearance between rotors (max.):	0.008	0.2032
Engine Lubrication		
Pressure at curb idle (min.): ④	6 psi	41.4 kPa
Pressure at 3000 rpm:	30-80 psi	207-552 kPa
Oil pressure switch		
Pressure drop resulting from a clogged filter:	7-9 psi	48.3-62.1 kPa

① Unless otherwise specified with a different measurement standard (for example, psi, kPa, lbs., N, etc.), this will be the measurement standard implied for all figures provided in this column

② Dry lash is the amount of clearance existing between the base circle of an installed cam and the rocker arm roller when the adjuster is drained of oil

③ Use a 1/16 in. (1.588mm) spacer to reduce spacing height when over specifications.

④ If oil pressure is 0 at idle, do not run it at 3000 rpm

88473C32

1994-96 5.2L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Cylinder Block		
Cylinder bore		
Standard size:	3.91-3.912	99.314-99.365
Maximum out-of-round:	0.005	0.127
Maximum taper:	0.01	0.254
Maximum oversize:	0.04	1.016
Distributor lower driveshaft		
Bushing (press fit in block)	0.0005-0.0140	0.127-0.3556
Shaft-to bushing clearance:	0.0007-0.0027	0.0178-0.0686
Tappet bore diameter:	0.9051-0.9059	22.99-23.01
Cylinder Head		
Compression pressure:	100 psi	689 kPa
Gasket thickness (compressed):	0.0475	1.2065
Valve seat		
Angle: 44.25-44.75 degrees		
Maximum runout:	0.003	0.0762
Width (finish)-intake:	0.04-0.06	1.016-1.542
Width (finish)-exhaust:	0.06-0.08	1.524-2.032
Hydraulic Lifters		
Body diameter:	0.9035-0.9040	22.949-22.962
Clearance in block:	0.0011-0.0024	0.0279-0.0610
Dry lash: ②	0.060-0.210	1.524-5.334
Pushrod length:	6.915-6.935	175.64-176.15
Valves		
Dimensions		
Face angle: 43.25-43.75		
Stem diameter:	0.311-0.312	7.899-7.925
Head diameter		
Intake:	1.916	48.666
Exhaust:	1.624	41.25
Length (overall)		
Intake:	4.893-4.918	124.28-125.92
Exhaust:	4.907-4.932	124.64-125.27
Stem-to-guide clearance:	0.001-0.003	0.0254-0.0762
Maximum allowable (rocking method):	0.017	0.4318
Valve guide head bore diameter (std.)	0.313-0.314	7.950-7.976
Valve guide reamer		
Oversize 1/valve guide size	0.003/0.316-0.317	0.076/8.026-8.052
Oversize 2/valve guide size	0.015/0.328-0.329	0.381/8.331-8.357
Lift (zero lash):	0.432	10.973
Valve Springs		
Installed height (spring seat to retainer):	1.64	41.66
Free length (approx.):	1.967	49.962
Spring tension		
Valve closed:	85 lbs. @ 1.64 in.	378 N @ 41.66mm
Valve open:	200 lbs. @ 1.212 in.	890 N @ 30.89mm
Number of coils: 6.8		
Wire diameter:	0.177	4.5
Valve Timing		
Intake valve		
Closes (ATC): 21 degrees		
Opens (BBC): 60 degrees		
Duration: 264 degrees		
Exhaust valve		
Closes (ABC): 61 degrees		
Opens (BTC): 10 degrees		
Duration: 250 degrees		
Valve overlap: 31 degrees		

88473C33

1994-96 5.2L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Crankshaft		
Connecting rod journals		
Diameter:	2.124-2.125	53.950-53.975
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Diametrical clearance:		
No. 1:	0.0005-0.0015	0.013-0.038
Nos. 2, 3 and 4:	0.0005-0.0020	0.013-0.051
Maximum allowable (Nos. 2, 3 and 4):	0.0025	0.064
Crankshaft end-play		
New part:	0.002-0.007	0.05-0.0178
Wear limit:	0.001	0.254
Main bearing journals		
Diameter:	2.4995-2.5005	63.487-63.513
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Connecting Rods		
Bearing clearance:	0.0005-0.0022	0.013-0.056
Maximum:	0.003	0.08
Piston pin bore diameter:	0.9829-0.9834	24.940-24.978
Side clearance:	0.006-0.014	0.152-0.356
Total weight (less bearing):	25.61 oz.	726 grams
Pistons		
Clearance at top of skirt:	0.0005-0.0015	0.0127-0.0381
Land clearance (diametrical):	0.025-0.040	0.635-1.016
Piston length:	3.4	86.36
Piston ring groove depth		
Nos. 1 and 2:	0.180-0.190	4.572-4.826
No. 3:	0.150-0.160	3.810-4.064
Weight:	20.9-21.04 oz.	592.6-596.6 grams
Piston Pins		
Clearance:		
In piston:	0.00025-0.00075	0.00635-0.01905
In rod (interference):	0.0007-0.0014	0.0178-0.0356
Diameter:	0.9841-0.9843	24.996-25.001
End-play:	0	0
Length:	2.990-3.010	75.946-76.454
Piston Rings		
Top compression		
End clearance:	0.010-0.020	0.254-0.508
Side clearance:	0.0015-0.0030	0.038-0.076
Ring width:	0.0776-0.0783	1.971-1.989
Bottom compression		
End clearance:	0.020-0.030	0.508-0.762
Side clearance:	0.0015-0.0030	0.038-0.076
Ring width:	0.0776-0.0783	1.971-1.989
Oil control		
End clearance:	0.010-0.050	0.254-1.270
Side clearance:	0.002-0.008	0.06-0.21
Ring width:	0.0776-0.0783	1.971-1.989
Camshaft		
Bearing diameter		
No. 1:	2.000-2.001	50.800-50.825
No. 2:	1.984-1.985	50.394-50.419
No. 3:	1.953-1.954	49.606-49.632
No. 4:	1.5625-1.5635	39.688-39.713
Diametrical clearance:	0.001-0.003	0.0254-0.0762
Max. allowable:	0.005	0.127
End-play:	0.002-0.010	0.051-0.254
Bearing journal diameter		
No. 1:	1.998-1.999	50.749-50.775
No. 2:	1.982-1.983	50.343-50.368
No. 3:	1.951-1.952	49.555-49.581
No. 4:	1.5605-1.5615	39.637-39.662

88473C34

1994-96 5.2L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Oil Pump		
Clearance over rotors (max.):	0.1016	0.004
Cover out-of-flat (max.):	0.0015	0.0381
Inner rotor thickness (min.).	0.825	20.955
Outer rotor		
Clearance (max.):	0.014	0.3556
Diameter (min.):	2.469	62.7126
Thickness (min.):	0.825	20.955
Tip clearance between rotors (max.):	0.008	0.2032
Oil Pressure		
Pressure at curb idle (min.): ③	6 psi	41.4 kPa
Pressure at 3000 rpm:	30-80 psi	207-552 kPa
Oil pressure switch		
Actuating pressure (min):	5-7 psi	34-48.3 kPa
Oil Filter		
Bypass valve setting:	9-15 psi	62-103 kPa

① Unless otherwise specified with a different measurement standard (for example, psi, kPa, lbs., N, etc.), this will be the measurement standard implied for all figures provided in this column

② Dry lash is the amount of clearance existing between the base circle of an installed cam and the rocker arm roller when the adjuster is drained of oil

③ If oil pressure is 0 at idle, do not run it at 3000 rpm

88473C35

1994-96 5.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Cylinder Block		
Cylinder bore		
Standard size:	4.000-4.002	101.60-101.65
Maximum out-of-round:	0.005	0.127
Maximum taper:	0.01	0.254
Maximum oversize:	0.04	1.016
Distributor lower driveshaft		
Bushing (press fit in block)	0.0005-0.0140	0.127-0.3556
Shaft-to bushing clearance:	0.0007-0.0027	0.0178-0.0686
Tappet bore diameter:	0.9051-0.9059	22.99-23.01
Cylinder Head		
Compression pressure:	100 psi	689 kPa
Gasket thickness (compressed):	0.0475	1.2065
Valve seat		
Angle: 44.25-44.75 degrees		
Maximum runout:	0.003	0.0762
Width (finish)-intake:	0.04-0.06	1.016-1.542
Width (finish)-exhaust:	0.06-0.08	1.524-2.032
Hydraulic lifters:		
Body diameter:	0.9035-0.9040	22.949-22.962
Clearance in block:	0.0011-0.0024	0.0279-0.0610
Dry lash: ②	0.060-0.210	1.524-5.334
Push rod length:	6.915-6.935	175.64-176.15
Valves		
Dimensions		
Face angle: 43.25-43.75		
Stem diameter:	0.311-0.312	7.899-7.925
Intake:	0.372-0.373	9.449-9.474
Exhaust:	0.371-0.372	9.423-9.449
Head diameter		
Intake:	1.88	47.752
Exhaust:	1.617	41.072
Length (overall)		
Intake:	4.969-4.994	126.21-126.85
Exhaust:	4.978-5.012	126.44-127.30
Stem-to-guide clearance:	0.001-0.003	0.0254-0.0762
Maximum allowable (rocking method):	0.017	0.4318
Valve guide head bore diameter (std.)	0.374-0.375	7.950-7.525
Valve guide reamer		
Oversize 1/valve guide size	0.003/0.316-0.317	0.076/8.026-8.052
Oversize 2/valve guide size	0.015/0.328-0.329	0.381/8.331-8.357
Valve springs		
Installed height (spring seat to retainer):	1.64	41.66
Free length (approx.):	1.967	49.962
Spring tension		
Valve closed:	85 lbs. @ 1.64 in.	378 N @ 41.66mm
Valve open:	200 lbs. @ 1.212 in.	890 N @ 30.89mm
Number of coils: 6.8		
Wire diameter:	0.177	4.5
Valve timing		
Intake valve		
Closes (ATC): 23 degrees		
Opens (BBC): 61 degrees		
Duration: 264 degrees		
Exhaust valve		
Closes (ABC): 80 degrees		
Opens (BTC): 13 degrees		
Duration: 274 degrees		
Valve overlap: 36.5 degrees		

88473C36

1994-96 5.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Crankshaft		
Connecting rod journals		
Diameter:	2.124-2.125	53.950-53.975
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Diametrical clearance:		
No. 1:	0.0005-0.0015	0.013-0.038
Maximum allowable (No. 1):	0.0015	0.0381
Nos. 2, 3 and 4:	0.0005-0.0020	0.013-0.051
Maximum allowable (Nos. 2, 3 and 4):	0.0025	0.064
End-play		
New part:	0.002-0.007	0.051-0.0178
Wear limit:	0.001	0.254
Main bearing journals		
Diameter:	2.8095-2.8105	71.361-71.387
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Connecting rods		
Bearing clearance:	0.0005-0.0022	0.013-0.056
Maximum:	0.003	0.08
Piston pin bore diameter:	0.9829-0.9834	24.940-24.978
Side clearance (two rods):	0.006-0.014	0.152-0.356
Total weight (less bearing):	25.74 oz.	758 grams
Pistons		
Clearance at top of skirt:	0.0005-0.0015	0.013-0.038
Land clearance (diametrical):	0.020-0.026	0.508-0.660
Piston length:	3.19	81.03
Piston ring groove depth		
Nos. 1 and 2:	0.187-0.193	4.761-4.912
No. 3:	0.157-0.164	3.996-4.177
Weight:	20.53-20.67 oz.	582-586 grams
Piston pins:		
Clearance:		
In piston:	0.00023-0.00074	0.006-0.019
Diameter:	0.9845-0.9848	25.007-25.015
End-play	0	0
Length:	2.67-2.69	67.8-68.3
Piston rings		
Top compression		
End clearance:	0.012-0.022	0.30-0.55
Side clearance:	0.0016-0.0033	0.040-0.085
Ring width:	0.060-0.061	1.530-1.555
Bottom compression		
End clearance:	0.55-0.80	0.508-0.762
Side clearance:	0.0016-0.0033	0.040-0.085
Ring width:	0.060-0.061	1.530-1.555
Oil control		
End clearance:	0.015-0.055	0.254-1.270
Side clearance.	0.002-0.008	0.05-0.21
Ring width:	0.018-0.019	0.447-0.473
Camshaft		
Bearing diameter		
No. 1:	2.000-2.001	50.800-50.825
No. 2:	1.984-1.985	50.394-50.419
No. 3:	1.953-1.954	49.606-49.632
No. 4:	1.5625-1.5635	39.688-39.713
Diametrical clearance:	0.001-0.003	0.0254-0.0762
Max. allowable:	0.005	0.127
End-play	0.002-0.010	0.051-0.254
Bearing journal diameter		
No. 1:	1.998-1.999	50.749-50.775
No. 2:	1.982-1.983	50.343-50.368
No. 3:	1.951-1.952	49.555-49.581
No. 4:	1.5605-1.5615	39.637-39.662

88473C37

1994-96 5.9L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Oil pump		
Clearance over rotors (max.):	0.1016	0.004
Cover out-of-flat (max.):	0.0015	0.0381
Inner rotor thickness (min.):	0.825	20.955
Outer rotor		
Clearance (max.):	0.014	0.3556
Diameter (min.):	2.469	62.7126
Thickness (min.):	0.825	20.955
Tip clearance between rotors (max.):	0.008	0.2032
Oil pressure		
Pressure at curb idle (min.): ③	6 psi	41.4 kPa
Pressure at 3000 rpm:	30-80 psi	207-552 kPa
Oil pressure switch		
Actuating pressure (min):	5-7 psi	34-48.3 kPa
Oil filter		
Bypass valve setting:	9-15 psi	62-103 kPa

① Unless otherwise specified with a different measurement standard (for example, psi, kPa, lbs., N, etc.), this will be the measurement standard implied for all figures provided in this column

② Dry lash is the amount of clearance existing between the base circle of an installed cam and the rocker arm roller when the adjuster is drained of oil

③ If oil pressure is 0 at idle, do not run it at 3000 rpm

88473C38

1994-96 8.0L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Cylinder Block		
Cylinder bore		
Standard size:	4.000-4.005	101.60-101.61
Maximum out-of-round:	0.005	0.127
Maximum taper:	0.01	0.254
Maximum oversize:	0.04	1.016
Tappet bore diameter:	0.9048-0.9059	22.982-23.010
Cylinder Head		
Compression pressure:	170-190 psi	1172-1310 kPa
Gasket thickness (compressed):	0.039-0.044	0.991-1.118
Valve seat		
Angle: 44.5 degrees		
Maximum-runout:	0.003	0.076
Width (finish)-intake and exhaust:	0.040-0.060	1.02-1.52
Guide bore diameter (std.):	0.313-0.314	7.95-7.98
Hydraulic Lifters		
Body diameter:	0.9035-0.9040	22.949-22.962
Clearance in block:	0.0008-0.0024	0.2030-0.0610
Plunger travel minimum (dry):	0.167	4.24
Pushrod length:	7.698-7.717	195.52-196.02
Valves		
Dimensions		
Face angle: 45 degrees		
Stem diameter:		
Intake:	0.372-0.373	9.449-9.474
Exhaust:	0.371-0.372	9.423-9.449
Head diameter		
Intake:	1.915-1.925	48.640-48.900
Exhaust:	1.619-1.629	41.123-41.377
Length (overall)		
Intake:	5.716-5.741	145.19-145.82
Exhaust:	5.730-5.755	145.54-146.18
Stem-to-guide clearance:	0.001-0.003	0.025-0.076
Maximum allowable (rocking method):	0.017	0.4318
Valve guide reamer		
Oversize 1/valve guide size	0.003/0.316-0.317	0.076/8.026-8.052
Oversize 2/valve guide size	0.015/0.328-0.329	0.381/8.331-8.357
Valve Springs		
Free length (approx.):	1.967	49.962
Spring tension		
Valve closed:	81-89 lbs. @ 1.64 in.	369-405 N @ 41.66mm
Valve open:	190-210 lbs. @ 1.216 in.	890 N @ 30.89mm
Number of coils: 6.79		
Wire diameter:	0.177	4.496
Valve Timing		
Intake valve		
Closes (ATC): 25 degrees		
Opens (BBC): 60 degrees		
Duration: 265 degrees		
Exhaust valve		
Closes (ABC): 61 degrees		
Opens (BTC): 6 degrees		
Duration: 246 degrees		
Valve overlap: 31 degrees		

88473C41

1994-96 8.0L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Crankshaft		
Connecting rod journals		
Diameter:	2.124-2.125	53.950-53.975
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Main bearing diametrical clearance:		
No. 1-6:	0.0002-0.0023	0.0051-0.0580
Maximum allowable:	0.0028	0.071
End-play		
New part:	0.003-0.012	0.00.076-0.30551-0.0178
Wear limit:	0.015	0.381
Main bearing journals		
Diameter:	2.9995-3.0005	76.187-76.213
Maximum out-of-round:	0.001	0.254
Maximum taper:	0.001	0.254
Connecting Rods		
Bearing clearance:	0.0002-0.0029	0.005-0.074
Piston pin bore diameter:	0.9829-0.9834	24.940-24.978
Side clearance (two rods):	0.010-0.108	0.25-0.46
Total weight (less bearing):	26.24 oz.	744 grams
Pistons		
Land clearance (diametrical):	0.0005-0.0015	0.013-0.038
Piston length:	3.25	82.5
Piston ring groove diameter		
Nos. 1 and 2:	3.594-3.604	91.30-91.55
No. 3:	3.657-3.667	92.90-93.15
Weight:	16.33-16.68	463-473
Piston Pins:		
Clearance:		
In piston:	0.0098-0.0218	0.006-0.019
In rod (interference):	0.0007-0.0024	0.018-0.061
Diameter:	0.9841-0.9843	24.996-25.001
End-play:	0	0
Length:	2.670-2.690	67.818-68.326
Piston Rings		
Top compression		
End clearance:	0.010-0.020	0.254-0.508
Side clearance:	0.0016-0.0033	0.040-0.085
Ring width:	0.060-0.061	1.530-1.555
Bottom compression		
End clearance:	0.010-0.020	0.254-0.508
Side clearance:	0.0016-0.0033	0.040-0.085
Ring width:	0.060-0.061	1.530-1.555
Oil control		
End clearance:	0.015-0.055	0.381-1.397
Side clearance:	0.0073-0.0097	0.185-0.246
Ring width:	0.102-0.108	2.591-2.743
Camshaft		
Bearing diameter		
No. 1:	2.093-2.094	53.16-53.19
No. 2:	2.077-2.078	52.76-52.78
No. 3:	2.061-2.062	52.35-52.37
No. 4:	2.045-2.046	51.94-51.97
No. 5	2.029-2.030	51.54-51.56
No. 6	1.919-1.920	48.74-48.77
Diametrical clearance:	0.001-0.003	0.0254-0.0762
Nos. 1 and No. 3-No. 6:	0.001-0.003	0.0254-0.0762
No. 2:	0.0015-0.0035	0.0381-0.0889
End-play:	0.005-0.015	0.127-0.381
Bearing journal diameter		
No. 1:	2.091-2.092	53.11-53.14
No. 2:	1.982-1.983	50.343-50.368
No. 3	2.059-2.060	52.30-52.32
No. 4	2.043-2.044	51.89-51.92
No 5:	2.027-2.028	51.49-51.51
No. 6:	1.917-1.918	48.69-48.72

88473C42

1994-96 8.0L ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Oil Pump		
Clearance over rotors (max.):	0.0075	0.1906
Cover out-of-flat (max.):	0.002	0.051
Inner rotor thickness (min.):	0.5876-0.5886	14.925-14.950
Outer rotor		
Clearance (max.):	0.006	1.626
Diameter (min.):	3.246	82.461
Thickness (min.):	0.5876	14.925
Tip clearance between rotors (max.):	0.023	0.584
Oil Pressure		
Pressure at curb idle speed: ②	12-25 psi	83-172 kPa
Pressure at 3000 rpm:	50-60 psi	345-414 kPa

① Unless otherwise specified with a different measurement standard (for example, psi, kPa, lbs., N, etc.), this will be the measurement standard implied for all figures provided in this column

② If oil pressure is 0 at idle, do not run it at 3000 rpm

88473C43

1994-96 DIESEL ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Cylinder Block		
Cylinder bore		
Standard size:	4.0203	102.116
Maximum out-of-round:	0.0015	0.038
Maximum taper:	0.003	0.076
Tappet bore diameter:	0.632	16.055
Top surface flatness (max. overall variation):	0.003	0.076
Max. variation at any 2 in. (50mm) diameter area:	0.0004	0.01
Refacing combustion deck		
1st reface:	0.0098	0.25
2nd reface:	0.0098	0.25
Total reface:	0.0197	0.5
Surface finish:	60-126 microinches	1.5-3.2 micrometers
Main bearing bore dia. (max.) w/o bearing installed:	3.2719	83.106
Camshaft bore diameter		
No. 1 w/o bushing:	2.2543	57.258
Nos. 1-7 with bushing:	2.1312	54.133
Cylinder Head		
Maximum overall flatness: ②	0.012	0.03
Valve seat angle		
Intake: 30 degrees		
Exhaust: 45 degrees		
Valve seat width		
Minimum:	0.06	1.52
Maximum:	0.08	2.03
Lifters		
Stem diameter:	0.627	15.925
Valves		
Clearance		
Intake:	0.01	0.25
Exhaust:	0.02	0.51
Guide diameter:	0.3157-0.3185	8.019-8.089
Stem diameter:	0.3126-0.3134	7.935-7.960
Depth (installed):	0.039-0.060	0.99-1.52
Valve springs		
Free standing length:	2.36	60mm
Inclination (max.):	0.039	1
Minimum load:	81 lbs @ 1.94 in.	359 N @ 49.25mm
Crankshaft		
Main bearing journal diameter		
Standard:	3.2662	82.962
Machined 0.0098 in. (0.25mm):	3.2564	82.712
Machined 0.0197 in. (0.50mm):	3.2465	82.462
Machined 0.0295 in. (0.75mm):	3.2367	82.212
Machined 0.0394 in. (1.00mm):	3.2269	81.962
Maximum out-of-round:	0.002	0.05
Maximum taper:	0.0005	0.013
Maximum oil clearance:	0.0047	0.119
Connecting rod journal diameter		
Standard:	2.715	68.962
Machined 0.0098 in. (0.25mm):	2.7052	68.712
Machined 0.0197 in. (0.50mm):	2.6954	68.462
Machined 0.0295 in. (0.75mm):	2.6855	68.212
Machined 0.0394 in. (1.00mm):	2.6757	67.962
Maximum out-of-round:	0.002	0.05
Maximum taper:	0.0005	0.013
Oil clearance:	0.0035	0.089
End clearance:	0.004-0.017	0.100-0.430
Gear backlash:	0.003-0.030	0.080-0.330
Connecting rods		
Pin bore diameter (max.):	1.5764	40.042
Side clearance:	0.004-0.012	0.100-0.300

88473C39

1994-96 DIESEL ENGINE REBUILDING SPECIFICATIONS

COMPONENT	U.S. (inches)①	Metric (millimeters)①
Pistons		
Clearance at top of skirt:	0.0005-0.0015	0.013-0.038
Land clearance (diametrical):	0.020-0.026	0.508-0.660
Piston length:	3.19	81.03
Piston ring groove depth		
Nos. 1 and 2:	0.187-0.193	4.761-4.912
No. 3:	0.157-0.164	3.996-4.177
Weight:	20.53-20.67 oz.	582-586 grams
Piston pins:		
Diameter (min.):	1.5744	39.99
Bore diameter (max.):	1.5758	40.025
Piston rings		
Ring end gap		
Top ring:	0.016-0.0275	0.400-0.700
Intermediate ring:	0.010-0.0215	0.250-0.550
Oil control ring:	0.010-0.0215	0.250-0.550
Camshaft		
Journal diameter (min.):	2.1245	53.962
Valve lobes (min. dia. @ peak of lobe)		
Intake:	1.852	47.04
Exhaust:	1.841	46.77
Lift pump lobe (min. dia. @ peak of lobe):	1.398	35.5
End clearance:	0.006-0.010	0.152-0.254
Gear backlash:	0.003-0.013	0.080-0.330
Oil pump		
Tip clearance (max.):	0.007	0.1778
Gerotor Drive/planetary to port plate clearance (max.):	0.005	0.127
Gerotor planetary to body clearance (max.):	0.015	0.381
Gear backlash (used pump):	0.003-0.015	0.080-0.380
Oil pressure		
Pressure at idle speed: ③	10 psi	69 kPa
Pressure at 2500 rpm:	30 psi	207 kPa
Oil pressure switch		
Regulating valve opening pressure:	5-7 psi	34-48.3 kPa
Oil filter		
Bypass valve setting:	65 psi	448 kPa

① Unless otherwise specified with a different measurement standard (for example, psi, kPa, lbs., N, etc.), this will be the measurement standard implied for all figures provided in this column

② Max. variation within 0.0004 (0.01mm) in any 2.0 in. (50.8mm) diameter area

③ If oil pressure is 0 at idle, do not run it at 2500 rpm

88473C40

4

DRIVEABILITY AND EMISSION CONTROLS

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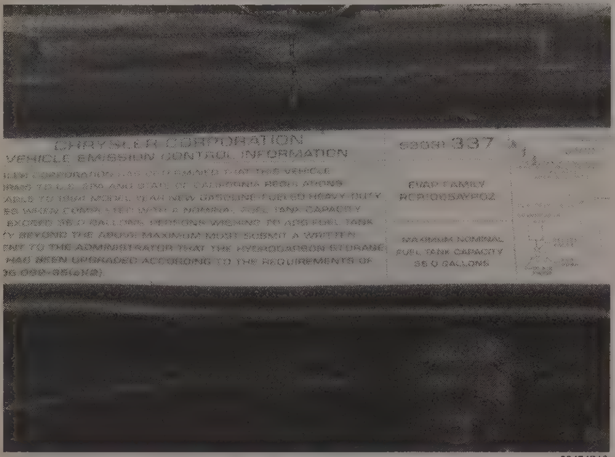
EMISSION CONTROLS

➧ See Figures 1 and 2



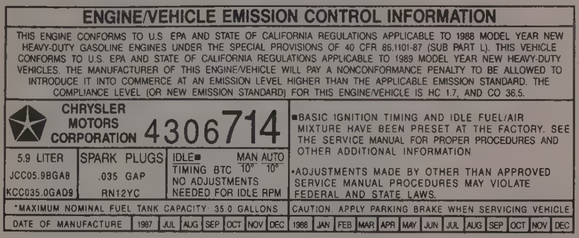
CHRYSLER CORPORATION
VEHICLE EMISSION CONTROL INFORMATION

EVAP FAMILY

MAXIMUM NOMINAL FUEL TANK CAPACITY 35.0 GALLONS

88474P10

Fig. 1 Vehicle emission control information can be found on a label under the hood



ENGINE/VEHICLE EMISSION CONTROL INFORMATION

THIS ENGINE CONFORMS TO U.S EPA AND STATE OF CALIFORNIA REGULATIONS APPLICABLE TO 1988 MODEL YEAR NEW HEAVY-DUTY GASOLINE ENGINES UNDER THE SPECIAL PROVISIONS OF 40 CFR 86.1101-87 (SUB PART L). THIS VEHICLE CONFORMS TO U.S. EPA AND STATE OF CALIFORNIA REGULATIONS APPLICABLE TO 1989 MODEL YEAR NEW HEAVY-DUTY VEHICLES. THE MANUFACTURER OF THIS ENGINE/VEHICLE WILL PAY A NONCONFORMANCE PENALTY TO BE ALLOWED TO INTRODUCE IT INTO COMMERCE AT AN EMISSION LEVEL HIGHER THAN THE APPLICABLE EMISSION STANDARD. THE COMPLIANCE LEVEL (OR NEW EMISSION STANDARD) FOR THIS ENGINE/VEHICLE IS HC 1.7, AND CO 36.5.

CHRYSLER MOTORS CORPORATION 4306714

■BASIC IGNITION TIMING AND IDLE FUEL/AIR MIXTURE HAVE BEEN PRESET AT THE FACTORY. SEE THE SERVICE MANUAL FOR PROPER PROCEDURES AND OTHER ADDITIONAL INFORMATION.

5.9 LITER	SPARK PLUGS	IDLE■	MAN	AUTO
JCC05.9BGA8	.035 GAP	TIMING BTC	10°	10°
KCC035.0GAD9	RN12YC	NO ADJUSTMENTS NEEDED FOR IDLE RPM		

•ADJUSTMENTS MADE BY OTHER THAN APPROVED SERVICE MANUAL PROCEDURES MAY VIOLATE FEDERAL AND STATE LAWS.

*MAXIMUM NOMINAL FUEL TANK CAPACITY: 35.0 GALLONS

CAUTION. APPLY PARKING BRAKE WHEN SERVICING VEHICLE

DATE OF MANUFACTURE	1987	JUL	AUG	SEP	OCT	NOV	DEC	1988	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

88474V01

Fig. 2 A common US Vehicle Emission Control Information (VECI) label—1989 version shown

Crankcase Ventilation System

OPERATION

Except 8.0L Engine

➧ See Figures 3, 4 and 5

All 2.5L, 3.9L, 5.2 and 5.9L engines are equipped with a Closed Crankcase Ventilation (CCV) system and a Positive Crankcase Ventilation (PCV) valve. The 8.0L engine is not equipped with a PCV valve, but its CCV system otherwise operates on the same principle and performs the same function.

On all but the 8.0L engine, the crankcase emission control equipment consists of PCV valve mounted on the cylinder head cover, with a hose extending from the valve to the base of the throttle body. A closed engine crankcase inlet air filter with a hose connecting it to the throttle body air cleaner housing provides the source of air for the system.

When the engine is running, a small portion of the gases which are formed in the combustion chamber leak past the piston rings and enter the crankcase. Since these gases are under pressure they tend to escape from the crankcase and enter into the atmosphere. If these gases are allowed to remain in the crankcase for any length of time, they would contaminate the engine oil and cause sludge to build up. If the gases are allowed to escape into the atmosphere, they would pollute the air, as they contain unburned hydrocarbons. The crankcase emission control equipment recycles these gases back into the engine combustion chamber, where they are burned.

The PCV system operates by manifold vacuum. Air is drawn from the throttle body air cleaner hose to the crankcase inlet air filter, passing through the filter into the crankcase. The air circulates inside the engine and is drawn out through the PCV valve. The gases pass through the PCV hose and into the throttle body where they become part of the air/fuel mixture.

The most critical component of the system (except for 8.0L engine) is the PCV valve. This vacuum-controlled valve regulates the amount of gases which are recycled into the combustion chamber. At low engine speeds the valve is partially closed, limiting the flow of gases into the intake manifold. As engine speed increases, the valve opens to admit greater quantities of the gases into the intake manifold. If the valve should become blocked or plugged, the gases will be prevented from escaping the crankcase by the normal route. Since these gases are under pressure, they will find their own way out of the crankcase. This alternate route is usually a weak oil seal or gasket in the engine. As the gas escapes by the gasket, it also creates an oil leak. Besides causing oil leaks, a clogged PCV valve also allows these gases to remain in the crankcase for an extended period of time, promoting the formation of sludge in the engine.

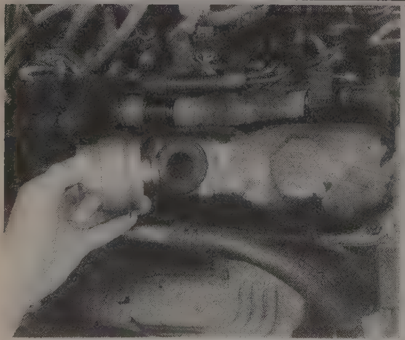
➡The fixed orifice tube is gray in color and is mounted on top of the right cylinder head cover. Do not confuse it with a similar black fitting on the left cylinder head (valve) cover.

8.0L Engine

In lieu of a PCV valve, the 8.0L engine makes use of a (gray) molded vacuum tube that connects manifold vacuum to the top of the right cylinder head (valve) cover. The vacuum tube connects to a fixed orifice fitting of a calibrated size of 0.10 in. (2.6mm). This fitting meters the amount of crankcase vapors drawn out of the engine.

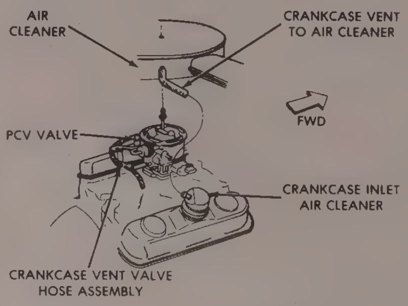
On the left cylinder head cover of the 8.0L engine is a similar black fitting that does not contain a fixed orifice. Do not interchange the gray and the black fittings.

The 8.0L engine CCV system operates as follows: When the engine is running, fresh air enters the engine and mixes with the crankcase vapors. This mixture of vapors and outside air is then drawn by manifold vacuum through the



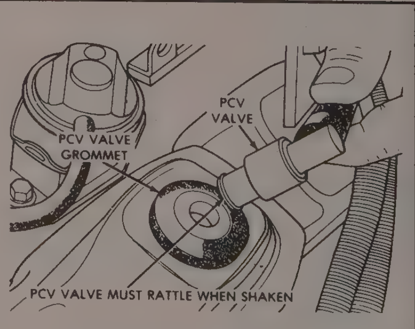
88474P11

Fig. 3 Fresh air enters the crankcase via the crankcase inlet air filter


AIR CLEANER
CRANKCASE VENT TO AIR CLEANER
FWD
PCV VALVE
CRANKCASE INLET AIR CLEANER
CRANKCASE VENT VALVE HOSE ASSEMBLY

88474003

Fig. 4 Positive Crankcase Ventilation (PCV) system—V6 engine



88474005

Fig. 5 The PCV valve fits into the sealing grommet as shown

fixed orifice tube into the intake manifold and into the combustion chamber where it is burned.

TROUBLESHOOTING

➧ **See Figures 6 and 7**

1. With the engine idling, pull the PCV valve and hose from the valve (rocker) cover rubber grommet.
2. A hissing noise should be heard as air passes through the valve. If the valve is working properly, a strong vacuum should be felt when you place a finger over the valve inlet. While you have your finger over the PCV valve inlet, check for vacuum leaks in the hose and at the connections.
3. Reinstall the PCV valve and wait a minute for pressure to drop.
4. Remove the crankcase intake air cleaner. Cover the opening with a piece of stiff paper. The paper should be sucked against the rocker cover with noticeable force.
5. Turn the engine **OFF**, then remove the PCV valve from the engine, a metallic clicking noise should be heard when it is shaken. This indicates that the metal check ball inside the valve is still free and is not gummed up. If no noise is heard, replace the valve. Since these valves are normally inexpensive components, it is smartest to replace the valve if it is suspected to be faulty.

COMPONENT TESTING

With the engine running, pull the PCV valve and hose from the valve rocker cover rubber grommet.

If the valve is working properly, a hissing noise should be heard as air passes through the valve and a strong vacuum should be felt when you place a finger over the valve inlet. While you have your finger over the PCV valve inlet, check for vacuum leaks in the hose and at the connections.

When the PCV valve is removed from the engine, a metallic clicking noise should be heard when it is shaken. This indicates that the metal check ball inside the valve is still free and is not gummed up.

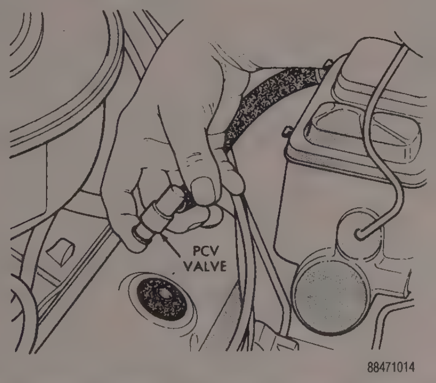


Fig. 6 Use your index finger to check for vacuum at the PCV valve

REMOVAL & INSTALLATION

PCV Valve

1. Pull the PCV valve and hose from the rubber grommet in the rocker cover.
2. Remove the PCV valve from the hose. Inspect the inside of the PCV valve. If it is dirty, disconnect it from the intake manifold and clean it in a suitable, safe solvent.
3. Installation is the reverse of removal.

Evaporative Emission Controls

OPERATION

➧ **See Figures 8 and 9**

Changes in atmospheric temperature cause fuel tanks to breathe; that is, the air within the tank expands and contracts with outside temperature changes. As the temperature rises, air escapes through the tank vent tube or the vent in the tank cap. Unless contained, the air which escapes will contain gasoline vapors.

The Evaporative Emission Control System (also called the EVAP system on later models) provides a sealed fuel system with the capability to store and condense gasoline vapors (diesel vehicles are not equipped with this system). The system has three parts: a fill control vent system; a vapor vent and storage system; and a pressure and vacuum relief system (special fill cap).

When fuel evaporates from the fuel tank, the vapors are vented to a carbon-filled evaporative (EVAP) canister where they are temporarily held until they can be drawn into the intake manifold.

The vapors are drawn into the engine at idle and off idle. This system employs a dual source of vacuum and is called a Bi-Level Purge System. The vacuum is controlled by the EVAP canister purge solenoid.

The purge solenoid is controlled by the engine controller computer. The computer regulates the solenoid by switching the ground circuit on and off based on engine operating conditions. When energized, the solenoid prevents vacuum from reaching the canister. When not energized, the solenoid allows vacuum to flow through to the canister.

All vehicles are equipped with a combination pressure relief and roll-over valve. The valve provides a path for fuel vapors to travel from the fuel tank to the canister and also provides fuel leakage protection should the vehicle become inverted through accident or carelessness. This valve incorporates a pressure relief mechanism which is designed to release pressure to the atmosphere when the fuel tank pressure increases beyond the calibrated setting.

These vehicles also use a sealed filler cap that has a pressure-vacuum relief valve. Under normal operating conditions, the filler cap operates as a check valve, allowing air to enter the tank to replace the fuel consumed. At the same time, it prevents vapors from escaping through the cap. In case of excessive pressure within the tank, the filler cap valve opens to relieve the pressure.

Because the filler cap is sealed, fuel vapors have only one place through which they may escape: the vapor separator assembly at the top of the fuel tank and into the evaporative (EVAP) canister.

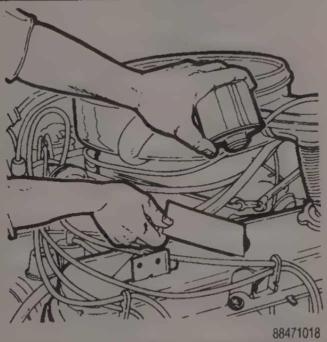


Fig. 7 Cover the rocker cover opening with a piece of heavy paper to check for vacuum

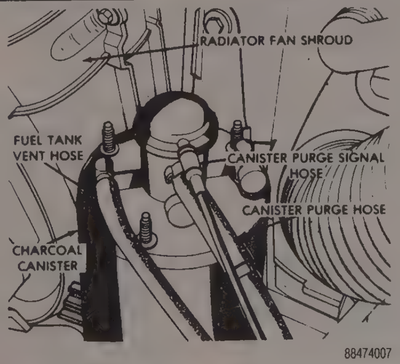


Fig. 8 An evaporative emission control canister as found on the Dakota

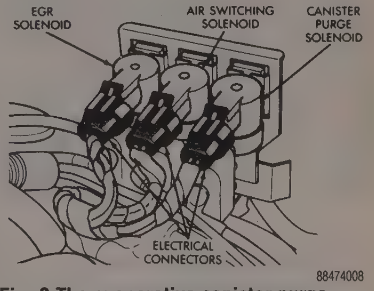


Fig. 9 The evaporative canister purge solenoid is located with other emissions control solenoids and shares a common mount near the right cylinder head—V6 and V8 engines

REMOVAL & INSTALLATION

Evaporative (EVAP) Canister

➧ See Figures 8 and 9

The evaporative canister is located on the right side wheel well on 1989–93 Ram and Ramcharger vehicles, and the left frame rail, near the left door for 1994–96 Ram vehicles. For Dakota models, it is found on the right side radiator closure panel (earlier models), or the right side inner fender (later models).

1. If necessary, raise and safely support the vehicle.
2. Detach the fuel lines/tubes at the canister. Make note of the location of these fittings prior to removal to allow proper installation.
3. Remove the mounting bolt at the canister mounting strap.
4. Remove the canister from the bracket.
5. Installation is the reverse of removal. Secure the canister mounting bolt to 95 inch lbs. (10 Nm).

Evaporative (EVAP) Canister Purge Solenoid

➧ See Figure 10

1. Remove the air cleaner housing assembly.
2. Disengage the wiring connector and vacuum harness from the solenoid.
3. Remove the solenoid and its support bracket from the intake manifold.
4. Remove the solenoid from the mounting bracket (on the 8.0L engine, it will snap off).
5. Installation is the reverse of removal. Secure the bracket to the intake manifold (for the 8.0L engine, the solenoid will snap in place).

Exhaust Gas Recirculation (EGR) System

OPERATION

The EGR system reduces oxides of nitrogen (NOx) in engine exhaust and helps prevent spark knock (pinging) by lowering combustion temperatures. It accomplishes this by allowing a small amount of hot exhaust gas to recirculate and dilute the incoming air/fuel mixture, thereby reducing peak flame temperatures. This system is utilized by gasoline engines only.

2.5L Engine

➧ See Figures 11 and 12

The 2.5L engine uses a ported vacuum-controlled EGR system. A vacuum signal from the throttle body activates the EGR valve diaphragm. As the vacuum signal increases it gradually opens the valve pintle allowing exhaust gases to flow. The amount of flow is directly proportional to the pintle position.

1989–91 V6 and V8 Engines

➧ See Figures 13, 14 and 15

The EGR system for 1989–91 V6 and V8 engines is the backpressure type. A backpressure transducer measures the amount of exhaust gas backpressure on the exhaust side of the EGR valve and varies the strength of the vacuum signal to the valve. This varied vacuum signal provides precise control over the amount of EGR allowed under all driving conditions.

88474P08

Fig. 10 The EVAP canister purge solenoid (arrow) is mounted above the exhaust manifold

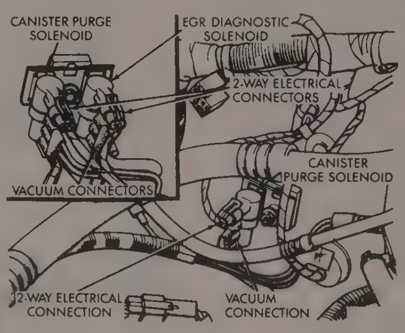

CANISTER PURGE SOLENOID
EGR DIAGNOSTIC SOLENOID
2-WAY ELECTRICAL CONNECTORS
CANISTER PURGE SOLENOID
VACUUM CONNECTORS
2-WAY ELECTRICAL CONNECTION
VACUUM CONNECTION
88474016

Fig. 11 Location of the diagnostic solenoid—2.5L California engine

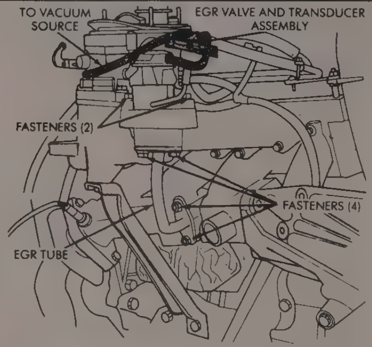

TO VACUUM SOURCE
EGR VALVE AND TRANSDUCER ASSEMBLY
FASTENERS (2)
FASTENERS (4)
EGR TUBE
88474014

Fig. 12 A common EGR tube and valve assembly as found on the 2.5L engine

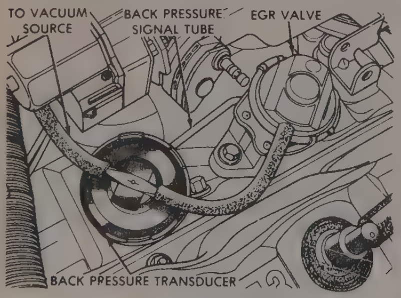

TO VACUUM SOURCE
BACK PRESSURE SIGNAL TUBE
EGR VALVE
BACK PRESSURE TRANSDUCER
88474015

Fig. 13 Location of the EGR valve—1989–91 V6 and V8 engines

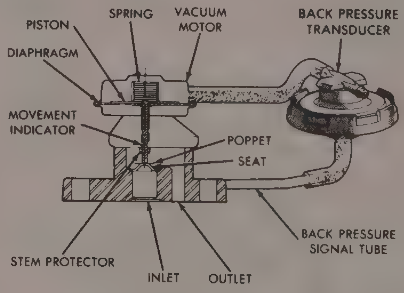

PISTON
SPRING
VACUUM MOTOR
BACK PRESSURE TRANSDUCER
DIAPHRAGM
MOVEMENT INDICATOR
POPPET
SEAT
BACK PRESSURE SIGNAL TUBE
STEM PROTECTOR
INLET
OUTLET
88474017

Fig. 14 A common EGR and backpressure transducer assembly—1989–91 models

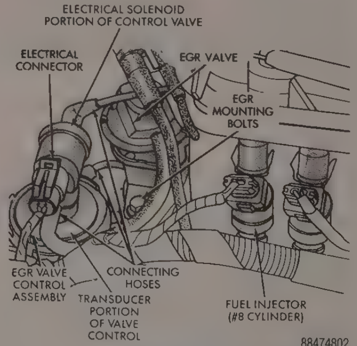

ELECTRICAL SOLENOID PORTION OF CONTROL VALVE
ELECTRICAL CONNECTOR
EGR VALVE
EGR MOUNTING BOLTS
EGR VALVE CONTROL ASSEMBLY
CONNECTING HOSES
TRANSDUCER PORTION OF VALVE CONTROL
FUEL INJECTOR (#8 CYLINDER)
88474802

Fig. 15 Location of the EGR system components—1992–96 V6 and V8 engine

1992 3.9L and 5.2L Engines; All 1993–96 Models

➧ See Figure 16

On 1992 3.9L and 5.2L models and all 1993–96 models, the EGR system is operated by an Electric exhaust gas recirculation Transducer (EET), which is a backpressure transducer and an electric vacuum solenoid combined into a single unit. With this evolutionary design, the engine controller computer now gets involved by regulating the vacuum solenoid using an electric signal. The vacuum solenoid then regulates the vacuum flowing through the transducer portion of the EET. The backpressure transducer measures the amount of exhaust gas backpressure to provide the correct amount of exhaust gas recirculation under various engine operating conditions. The information regarding engine operating conditions is supplied to the engine controller by the various sensors which monitor the engine, such as the engine coolant temperature sensor.

➡If the electrical connector to the EGR valve control is disconnected (1992–96 3.9L and 5.2L gasoline vehicles), or the electrical signal is lost, the EGR will be stuck on at all times resulting in poor performance and driveability.

On 1992 5.9L models, the EGR purge solenoid is operated by the engine controller. The engine controller monitors engine operating conditions to determine when to energize the solenoid. When the solenoid is not energized, vacuum flows through the solenoid to the vacuum transducer. The vacuum transducer is controlled by exhaust system backpressure. When the backpressure is high enough to close a bleed valve in the transducer, vacuum will flow to the EGR valve. If backpressure does not close the bleed valve, vacuum will be bled off.

Early California vehicles covered by this manual and all 1994–96 models have an On-Board Diagnostic system incorporated to monitor their EGR systems. The diagnostic system uses a solenoid in the vacuum signal line to the EGR valve. The diagnostic check is activated only during selected engine/driving conditions to avoid misdiagnosis. The diagnostics check the entire EGR system for failures. The engine controller computer monitors EGR system performance and stores a trouble code if a failure is detected. If a trouble code is stored, the CHECK ENGINE light will come on.

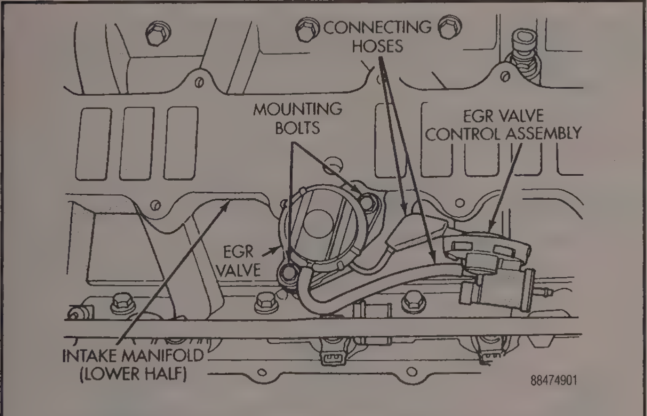


Fig. 16 Location of the EGR system components—8.0L engine

COMPONENT TESTING

➡The 8.0L EGR system test can only be performed with a professional diagnostic tool, the DRBII scan tool, and is thus not included in this manual.

A failed or malfunctioning EGR system can cause engine spark knock, sags or hesitation. To assure proper operation, all EGR passages and moving parts must be free from heavy carbon deposits, which will plug up the passages and make valves stick. It's also important to make sure there are no leaks in the system.

Inspect all hoses and connections between the throttle body, intake manifold, EGR control valve and EGR solenoid. Replace any melted or cracked nylon lines or split rubber elbows in the vacuum harness. Any vacuum hoses or components found to be leaking should be replaced.

EGR Control System Test

Start and warm up the engine. Allow it to idle with the parking brake firmly set. Allow the engine to idle in Neutral with the throttle closed, then quickly accelerate the engine speed to approximately 2000 rpm. Watch the EGR movement indicator (groove) on the valve stem. If the valve stem moves, the EGR system is operating correctly. If no movement is noted, refer to the EGR diagnosis chart for valve checks.

EGR Gas Flow Test

1. Connect a tachometer to the engine.
2. Remove the vacuum hose or rubber elbow from the EGR valve and connect a hand vacuum pump to the EGR valve vacuum nipple.
3. Start the engine and slowly apply vacuum to the EGR valve diaphragm.
4. The engine speed should drop as vacuum reaches 3–5 in. Hg (10–17 kPa) and continue to drop as more vacuum is applied. The engine may even stall. This means EGR gas is flowing through the system.
5. If the engine speed doesn't drop, check for a failed EGR valve or plugged EGR passage. Remove the EGR valve for inspection and cleaning, if necessary. Remove the EGR tube on 2.5L engines and inspect it for plugging.

EGR Valve Leakage Test

This procedure applies only to electrically operated EGR valves.

This is not to be used as a complete test of the EGR system. If the engine will not idle, dies out on idle, or the idle is rough or slow, the poppet valve at the base of the EGR valve may be leaking in the closed position. The diaphragm within the EGR valve may also be ruptured.

1. The engine should be off for this test.
2. Disconnect the rubber hose from the fitting at the top (vacuum motor) side of the EGR valve.
    a. Connect a hand-held vacuum pump to this fitting.
    b. Apply 15 in. Hg (50.65 kPa) of vacuum to the pump and observe the gauge reading. If the vacuum falls off, the diaphragm is ruptured.
    c. Replace the EGR valve.

➡The EGR valve, valve control and attaching hoses are serviced as one unit.

    d. Proceed to the next step.

3. A small metal backpressure fitting is located at the base of the EGR valve control. Disconnect this rubber hose at the EGR valve fitting.
4. Remove the air cleaner housing from the throttle body. Using compressed air, and an open nozzle with rubber tip, apply approximately 50 psi (345 kPa) to the metal backpressure fitting on the EGR valve.
5. Manually open the throttle to wide open position. Air should NOT be heard from the intake manifold while applying the high pressure air.

➡The EGR valve, valve control and attaching hoses are serviced as one unit.

6. If air CAN be heard, the poppet valve is leaking. Replace the EGR valve.

Vacuum Transducer Test

The first portion of this test will tell whether the transducer at the backpressure side of the control valve has ruptured or is leaking. The second part of the test will determine if engine vacuum (full-manifold) is flowing from the inlet to the outlet side of the control valve. This is not a complete test of the EGR system.

1. Electrical operation of the valve control should be first checked with a DRBII scan tool, or equivalent before proceeding with the vacuum test.
2. If you do not have a scan tool, but have reason to believe the electrical signal from the engine controller is functioning normally, proceed by disconnecting the rubber backpressure hose from the fitting at the bottom of the EGR control valve.
3. Connect a hand-held vacuum pump to this fitting and apply 10 in. Hg (34 kPa) of vacuum to this fitting.
4. If the vacuum falls off, the valve control diaphragm is leaking.
5. Replace the EGR valve. Proceed to the next step for further testing.
6. Remove the rubber hose at the vacuum inlet fitting on the EGR valve control.
7. Connect a vacuum gauge to this disconnected hose.

8. Start the engine and bring it to operating temperature. Hold the engine at approximately 1500 rpm.
9. Check for steady engine vacuum (full-manifold) at this hose.
10. If engine vacuum is not present, check the vacuum line to the engine and repair as necessary before proceeding to the next step.
11. Reconnect the rubber hose to the vacuum INLET fitting on the EGR valve control.
12. Disconnect the rubber hose at the vacuum OUTLET fitting on the EGR valve control.
13. Connect a vacuum gauge to this fitting.
14. Unplug the electrical connector at the valve control to simulate an open circuit (no ground from the engine controller) at the valve control.
15. Start the engine and bring it to operating temperature. Hold the engine at approximately 2000 rpm while checking for vacuum (full-manifold) at this fitting. Remember, to allow manifold vacuum to flow through the valve control, exhaust backpressure must be present at the valve control. It must be high enough to hold the bleed valve in the transducer portion of the valve control closed. Have a helper momentarily (a second or two) hold a rag over the tailpipe opening to build some exhaust backpressure while observing the vacuum gauge. Heavy gloves should be worn.
16. As temporary backpressure is built, full manifold vacuum should be observed at the vacuum control outlet fitting. Without backpressure, and the engine at approximately 2000 rpm, the gauge reading will be low. This reading is normal. At idle speed, the gauge reading will be erratic. This is also normal.
17. If full manifold vacuum is not present at the outlet fitting, but was present at the inlet fitting, replace the valve control.

➡The EGR valve, valve control and attaching hoses are serviced as one unit.

REMOVAL & INSTALLATION

EGR Valve

➧ See Figure 17

1. Disconnect the vacuum line to the EGR valve. Inspect for damage.
2. Remove the EGR valve mounting bolts from the intake manifold.
3. Remove the EGR valve from the intake manifold.
4. Clean the gasket surface and discard the old gasket. Check for any signs of leakage or cracked surfaces.
5. Installation is the reverse of removal. Secure the EGR valve mounting bolts to 17 ft. lbs. (22 Nm).

Catalytic Converter

The catalytic converter, mounted in the exhaust system, is a muffler-shaped device designed to reduce tailpipe emissions. It contains a ceramic honeycomb shaped material coated with alumina and impregnated with catalytically active precious metals such as platinum, palladium and rhodium.

88474P07

Fig. 17 Unbolt and remove the EGR valve

The catalyst's job is to reduce air pollutants by oxidizing hydrocarbons (HC) and carbon monoxide (CO). Catalysts containing palladium and rhodium also oxidize nitrous oxides (NOx).

On some trucks, the catalyst is also fed by the secondary air system, via a small supply tube in the side of the catalyst.

No maintenance is possible on the converter, other than keeping the heat shield clear of flammable debris, such as leaves and twigs.

Other than external damage, the only significant damage possible to a converter is through the use of leaded gasoline which will clog it, or through (excessive) heat-caused melting resulting from a too rich or too lean fuel/air mixture. Both of these problems will ruin the converter through contamination of the catalyst and will eventually plug the converter causing loss of power and engine performance.

When this occurs, the catalyst must be replaced. For catalyst replacement, see the exhaust system procedures in Section 3.

Air Injection System

OPERATION

➧ See Figures 18, 19 and 20

The air injection system is used to inject fresh air into the exhaust manifolds or catalytic converters via an air control valve. Under some operating conditions, the air can be dumped back into the atmosphere via an air bypass valve. On some applications the two valves are combined into one unit. The air bypass valve can be either the normally closed type, when the valves are separate, or the normally open type, when the valves are combined.

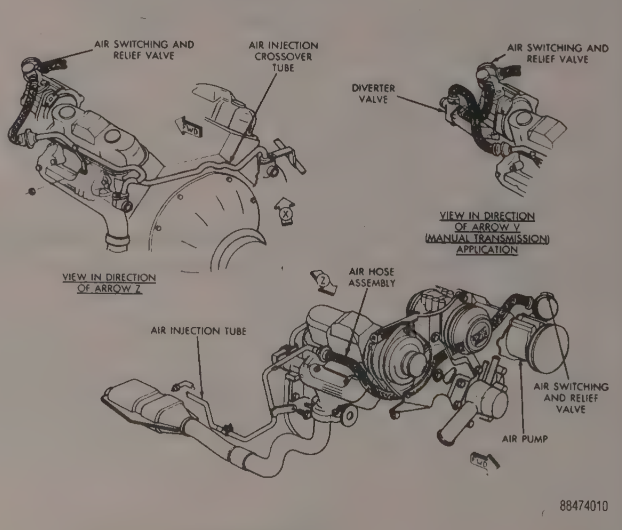
The system uses a diverter valve which is used to prevent backfire in the exhaust system during sudden deceleration. When the throttle is suddenly closed, a too-rich air/fuel mixture may be created which could not normally be burned. This mixture becomes burnable when it reaches the exhaust area and combines with the injected air. The diverter valve senses the sudden increase in the intake manifold vacuum causing the valve to open, allowing air from the air pump to pass through the valve and silencer into the atmosphere.

➡Do not attempt to correct pump noise by lubricating the air pump. Never lubricate the air pump. Do not assume a pump is bad just because it's noisy.

COMPONENT TESTING

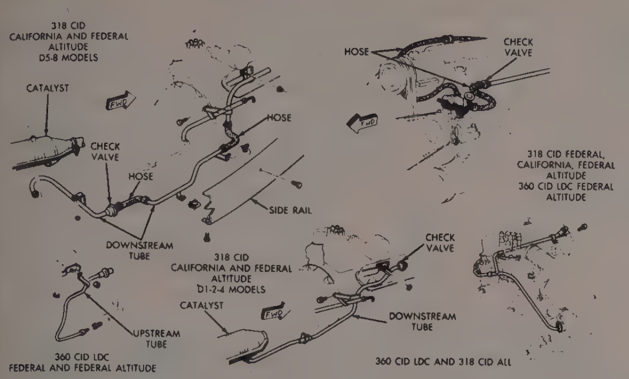
Normally Closed Air Bypass Valve Functional Test

1. Disconnect the air supply hose at the valve.
2. Run the engine to normal operating temperature.


AIR SWITCHING AND RELIEF VALVE
AIR INJECTION CROSSOVER TUBE
DIVERTER VALVE
AIR SWITCHING AND RELIEF VALVE
VIEW IN DIRECTION OF ARROW V (MANUAL TRANSMISSION) APPLICATION
VIEW IN DIRECTION OF ARROW Z
AIR HOSE ASSEMBLY
AIR INJECTION TUBE
AIR SWITCHING AND RELIEF VALVE
AIR PUMP

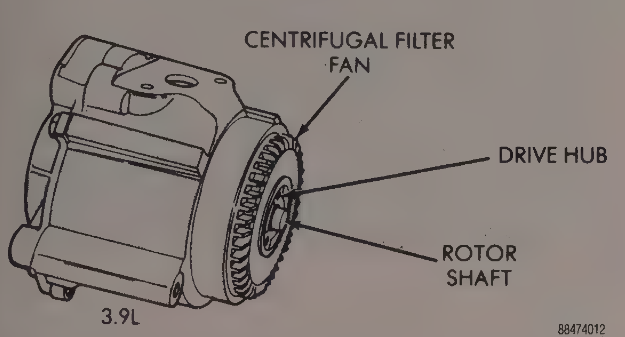
88474010

Fig. 18 Typical air injection system



88474011

Fig. 19 A common air injection system—V8 engine shown, others similar



88474012

Fig. 20 A common air pump—3.9L model shown

3. Disconnect the vacuum line and make sure vacuum is present. If no vacuum is present, remove or bypass any restrictors or delay valves in the vacuum line.
4. Run the engine at 1500 rpm with the vacuum line connected. Air pump supply air should be heard and felt at the valve outlet.
5. With the engine still at 1500 rpm, disconnect the vacuum line. Air at the outlet should shut off or dramatically decrease. Air pump supply air should now be felt or heard at the silencer ports.
6. If the valve doesn't pass each of these tests, replace it.

Normally Open Air Bypass Valve Functional Test

1. Disconnect the air supply hose at the valve.
2. Run the engine to normal operating temperature.
3. Disconnect the vacuum lines from the valve.
4. Run the engine at 1500 rpm with the vacuum lines disconnected. Air pump supply air should be heard and felt at the valve outlet.
5. Shut **OFF** the engine. Using a spare length of vacuum hose, connect the vacuum nipple of the valve to direct manifold vacuum.
6. Run the engine at 1500 rpm. Air at the outlet should shut off or dramatically decrease. Air pump supply air should now be felt or heard at the silencer ports.
7. With the engine still in this mode, cap the vacuum vent. Accelerate the engine to 2000 rpm and suddenly release the throttle. A momentary interruption of air pump supply air should be felt at the valve outlet.
8. If the valve doesn't pass each of these tests, replace it. Reconnect all lines.

Air Control Valve Functional Test

1. Run the engine to normal operating temperature, then increase the speed to 1500 rpm.
2. Disconnect the air supply hose at the valve inlet and verify that there is airflow present.
3. Reconnect the air supply hose.
4. Disconnect both air supply hoses.
5. Disconnect the vacuum hose from the valve.
6. With the engine running at 1500 rpm, airflow should be felt and heard at the outlet on the side of the valve, with no airflow heard or felt at the outlet opposite the vacuum nipple.
7. Shut **OFF** the engine.
8. Using a spare piece of vacuum hose, connect direct manifold vacuum to the valve's vacuum fitting. Airflow should be heard and felt at the outlet opposite the vacuum nipple, and no airflow should be present at the other outlet.
9. If the valve is not functioning properly, replace it.

Air Supply Pump Functional Check

1. Check and, if necessary, adjust the belt tension. Press at the mid-point of the belt's longest straight run. You should be able to depress the belt no more than ½ in. (13mm).
2. Run the engine to normal operating temperature and let it idle.
3. Disconnect the air supply hose from the bypass control valve. If the pump is operating properly, airflow should be felt at the pump outlet. The flow should increase as you increase the engine speed. The pump is not serviceable and should be replaced if it is not functioning properly.

REMOVAL & INSTALLATION

Air Injection Pump

3.9L, 5.9L AND 8.0L ENGINES

1. Disconnect both of the hoses (tubes) at the air injection pump.
2. Loosen (but do not remove at this time) the air pump pulley mounting bolts.
3. Relax the belt tensioner and remove the belt.
4. Remove the air pump pulley bolts and remove the pulley from the pump.
5. Remove the two air pump mounting bolts and remove the pump from the bracket.
6. Installation is the reverse of removal. Secure the pump mounting bolts to 30 ft. lbs. (40 Nm). Tighten the pump pulley bolts to 9 ft. lbs. (11 Nm).

Air Injection Pump Air Filter

8.0L ENGINE ONLY

1. Remove the silencer tube at the housing.
2. Remove the air inlet tube at the housing.
3. Remove the rubber cap.
4. Remove the mounting bracket strap bolt.
5. Note the position of the tube fittings before removing the filter assembly from the bracket. Gently bend the strap and remove the filter assembly.
6. Installation is the reverse of removal.

Heated Air Intake System

➧ See Figures 21, 22 and 23

The heated air intake system is part of the air cleaner assembly. It controls the intake air temperature so the air/fuel mixture can be calibrated leaner when ambient temperatures are low. The system improves engine warm-up characteristics and minimizes icing problems in cold weather.

When ambient air temperature is 15°F (8°C) or more above the control temperature, air flow is deflected through the outside air inlet. When the ambient temperature is below these values, warm intake air flow is taken from the heat stove on the exhaust manifold. The colder the temperature, the greater the amount of air taken through the stove. Air flow is controlled by a vacuum-operated door in the snorkel.

Modulation of induction air temperature is controlled by intake manifold vacuum, a temperature sensor and vacuum diaphragm. Temperature modulation only occurs at road load throttle positions or when the intake manifold vacuum is above the operating vacuum of the diaphragm.

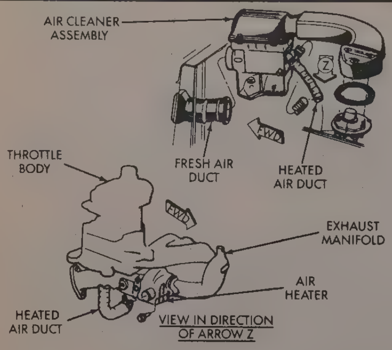

AIR CLEANER ASSEMBLY
THROTTLE BODY
FRESH AIR DUCT
HEATED AIR DUCT
EXHAUST MANIFOLD
AIR HEATER
HEATED AIR DUCT
VIEW IN DIRECTION OF ARROW Z
88474018

Fig. 21 Components of the heated air intake system as found on the 2.5L engine

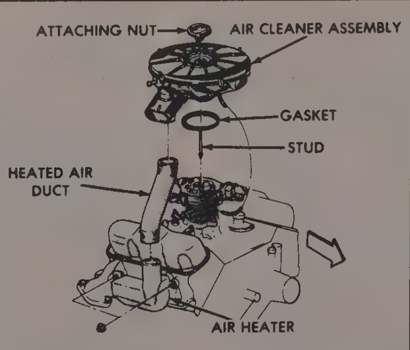

ATTACHING NUT
AIR CLEANER ASSEMBLY
GASKET
STUD
HEATED AIR DUCT
AIR HEATER
88474019

Fig. 22 Exploded view of the heated air intake system—V6 engine

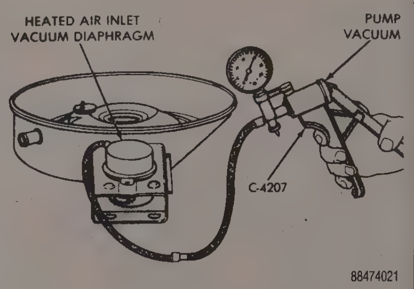

HEATED AIR INLET VACUUM DIAPHRAGM
PUMP VACUUM
C-4207
88474021

Fig. 23 Use a hand-held vacuum pump to test the air cleaner vacuum diaphragm

TESTING

Improper operation of the heated air intake system will cause driveability problems and high emissions. Make sure all vacuum hoses and the stove to the air cleaner flexible connector are properly attached and in good condition. With a cold engine and ambient temperature below 110°F (44°C), the heat control door in the snorkel should be in the UP position. With the engine warmed up and running, or when the intake air temperature goes above 130°F (54°C), the control door should be in the DOWN position.

To test the door control diaphragm, use a hand vacuum pump to apply 25 in. Hg (84.5 kPa). The diaphragm should not bleed down more than 10 in. Hg (34 kPa) in 5 minutes. The door should not lift off the bottom of the snorkel with less than 2 in. Hg (6.75 kPa) of vacuum applied. The door should be in the full UP position with 4 in. Hg (13.5 kPa) applied. If the vacuum diaphragm does not perform as described, replace it.

REMOVAL & INSTALLATION

Vacuum Diaphragm

➧ **See Figure 24**

1. Remove the air cleaner from the vehicle.
2. Disconnect the vacuum hose from the blend door diaphragm.
3. Drill out the diaphragm mounting rivet. Tip the diaphragm slightly forward to disengage the lock. When the diaphragm is free, slide the complete assembly to one side to disengage the operating rod from the blend air door.
4. With the diaphragm removed from the air cleaner, check the blend air door for freedom of travel. When the door is raised, it should fall freely. Adjust as necessary.
5. Place the diaphragm in position on the air cleaner and engage the rod to the blend air door. Mount the diaphragm with a rivet.
6. Apply 4 in. Hg (13.5 kPa) of vacuum to the diaphragm. The control door should operate freely.
7. Install the air cleaner, start the engine and check the blend air door operation.

Heated Air Temperature Sensor

➧ **See Figure 25**

1. Remove the air cleaner from the vehicle.
2. Remove and discard the sensor mounting clip. Remove the sensor.
3. Position the mounting gasket on the sensor. Install the sensor in position on the air cleaner.
4. Support the sensor and slide the new retainer into position. Make sure the sensor is secure and in the proper position with the mounting gasket to ensure a tight air seal.

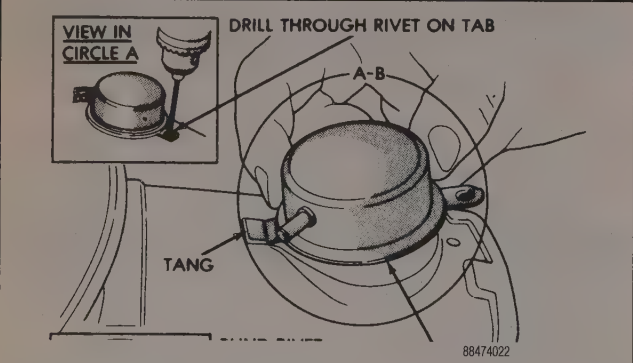

VIEW IN CIRCLE A
DRILL THROUGH RIVET ON TAB
A-B
TANG
88474022

Fig. 24 Drill out and remove the rivet

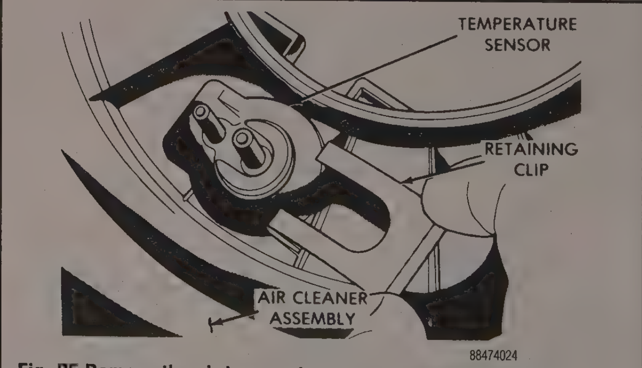

TEMPERATURE SENSOR
RETAINING CLIP
AIR CLEANER ASSEMBLY
88474024

Fig. 25 Remove the air temperature sensor retaining clip and remove the sensor

ELECTRONIC ENGINE CONTROLS

Engine Controller

Although the engine controller computer performs essentially the same function for all models covered by this manual, it has been called a few different names over the years. On 1989 models the manufacturer called it the Single Module Engine Controller (SMEC); on 1990–91 models it was called the Single Board Engine Controller (SBEC); for 1992 it was simply known as the Engine Controller, and since 1993 it has been called the Powertrain Control Module (PCM). The unit is found in the engine compartment mounted to the left or right side inner fender or the firewall, depending on application. For simplicity's sake, in this manual it will generally be called the engine controller.

The engine controller is an on-board digital computer. It has a built-in microprocessor which continually receives input from various engine sensors. Input data is fed to the computer by sensors located in the engine compartment.

The program schedule module of the engine controller receives the information from the sensors, processes it, then directs the ignition control module to advance or retard the timing as necessary. This whole process goes on continuously as the engine is running, taking only milliseconds to complete a circuit from sensor-to-distributor.

REMOVAL & INSTALLATION

▸ See Figures 26, 27, 28, 29 and 30

1. Disconnect the negative battery cable.
2. On 1989 models, unfasten the retaining screw and remove the 14-way connector and the 60-way connector from the engine controller.
3. On 1990–95 models, unfasten the retaining screw, then remove the 60-way connector from the engine controller.
4. On 1996 models, carefully unplug the three 32-way connectors.
5. If fender-mounted and hidden in the air intake, remove any hoses or the air tract compartment, as necessary, to access the controller.
6. Remove the engine controller mounting bolts.
7. Remove the engine controller. If mounted in a container, remove the lid for access.
8. Installation is the reverse of removal. Check to ensure the pins are all straight in the multi-pin connector(s). Repair as necessary.
9. Position the engine controller and install the mounting bolts. Tighten the bolts to 9 inch lbs. (1 Nm). If mounted in a black box, install it as when it was removed.
10. Plug-in the multi-pin connector(s) to the engine controller. Tighten the bolt to 35 inch lbs. (4 Nm).

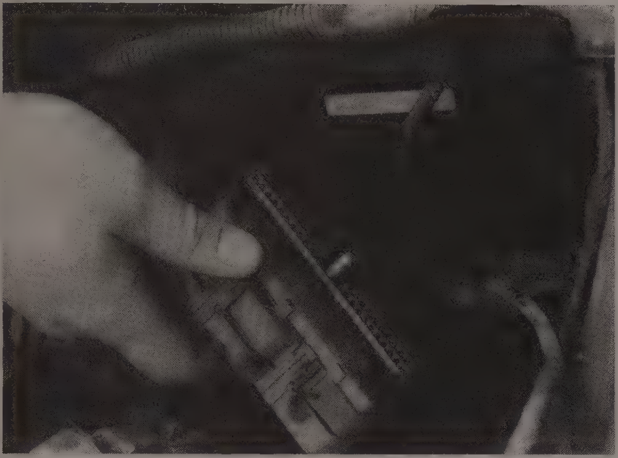


Fig. 26 Unscrew and remove the 60-way connector from the engine controller

Oxygen Sensor

OPERATION

▸ See Figures 31 and 32

The oxygen sensor is located in the exhaust manifold and is a device which produces an electrical voltage when exposed to the oxygen present in the exhaust gases. The sensor is electrically heated for more efficient monitoring when the engine is running. When a large amount of oxygen is present (lean mixture), the oxygen sensor produces a low voltage. When there is less oxygen present (rich mixture), the sensor produces a high voltage.

By monitoring the oxygen content and converting it into a voltage signal, the sensor acts as a rich/lean switch for the SMEC/SBEC computer, which regulates the fuel delivery to compensate accordingly.

The oxygen sensor is located in the exhaust manifold or the Y-pipe on the right side of the vehicle. A special tool (C–4907) is necessary for sensor removal and installation.

Fig. 27 Remove hose(s) as necessary to access the engine controller—fender-mounted unit shown

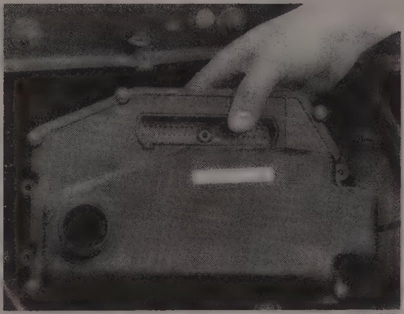


Fig. 28 The controller may be mounted in a box in-line with the cooling air intake—1990 Ram shown

Fig. 29 Unfasten the screws which secure the cover to the black box . . .

Fig. 30 . . . and remove the lid to access the engine controller

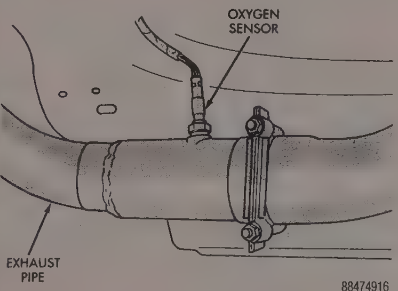


Fig. 31 A single oxygen sensor—4-cylinder, V6 and light duty 5.2L and 5.9L V8 engines

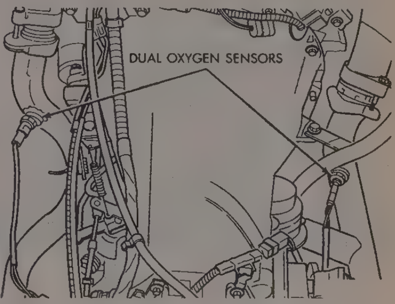


Fig. 32 A dual oxygen sensor arrangement—heavy duty V8 and V10 engines

TESTING

1. Start the engine and bring it to normal operating temperature, then run the engine above 1200 rpm for two minutes.
2. Backprobe with a high impedance averaging voltmeter (set to the DC voltage scale) between the oxygen sensor (02S) and battery ground.
3. Verify that the 02S voltage fluctuates rapidly between 0.40–0.60 volts.
4. If the 02S voltage is stabilized at the middle of the specified range (approximately 0.45–0.55 volts) or if the 02S voltage fluctuates very slowly between the specified range (02S signal crosses 0.5 volts less than 5 times in ten seconds), the 02S may be faulty.
5. If the 02S voltage stabilizes at either end of the specified range, the engine controller is probably not able to compensate for a mechanical problem such as a vacuum leak or a high float level. These types of mechanical problems will cause the 02S to sense a constant lean or constant rich mixture. The mechanical problem will first have to be repaired and then the 02S test repeated.
6. Pull a vacuum hose located after the throttle plate. Voltage should drop to approximately 0.12 volts (while still fluctuating rapidly). This tests the ability of the 02S to detect a lean mixture condition. Reattach the vacuum hose.
7. Richen the mixture using a propane enrichment tool. Voltage should rise to approximately 0.90 volts (while still fluctuating rapidly). This tests the ability of the 02S to detect a rich mixture condition.
8. If the 02S voltage is above or below the specified range, the 02S and/or the 02S wiring may be faulty. Check the wiring for any breaks, repair as necessary and repeat the test.

REMOVAL & INSTALLATION

➧ See Figure 33

On 2.5L engines, the oxygen sensor is located on the exhaust manifold. On 3.9L engines, the oxygen sensor is located in the exhaust Y-pipe. On 5.2L and light duty 5.9L engines, it is located above the outlet of the left exhaust manifold. On heavy duty 5.9L and 8.0L engines, dual oxygen sensors are found on each exhaust downpipe.

✻✻✻ CAUTION

The exhaust manifold/pipe get extremely hot during engine operation and if touched can cause severe burns. If servicing the oxygen sensor when the engine is hot, avoid contact with the exhaust manifold or pipe.

➡A special tool C-4907, or a box wrench or a suitable oxygen sensor wrench is required to remove the oxygen sensor. Do not pull on the oxygen sensor wires!

1. Disconnect the wiring harness from the oxygen sensor.
2. Remove the sensor using the appropriate tool.

➡The oxygen sensor threads are coated with an anti-seize compound. The compound must be removed from the mounting boss threads, either in the exhaust manifold or Y-pipe. An 18mm x 1.5 x 6E tap is required.

3. Installation is the reverse of removal. Secure the sensor to 20 ft. lbs. (27 Nm).

Idle Air Control (IAC) Motor

OPERATION

➧ See Figures 34 and 35

The IAC motor is mounted to the throttle body and is operated by the engine controller. The throttle body has an air control passage that provides air for the engine at idle (when the throttle plate is closed). The IAC motor pintle protrudes into the air control passage and regulates air flow through it. Based on various sensor inputs, the engine controller adjusts engine idle speed by moving the IAC motor pintle in and out of the air control passage. The IAC motor is positioned when the ignition key is turned to the **ON** position.

➡Never attempt to adjust the engine idle speed using the factory adjusted set screw.

A factory adjusted set screw is used to mechanically limit the position of the throttle body throttle plate. All idle speed functions are controlled by the engine controller.

TESTING

➧ See Figures 36 and 37

The IAC motor is mounted to the throttle body.

To perform a complete test of the IAC motor, you will need the DRBII scan tool, or equivalent. This test is a test of the IAC motor only. You will need access to the special factory IAC motor exerciser tool No. 7558.

Take the following precautions before beginning:

- Set the parking brake and block the drive wheels.
- Route all tester cables away from the cooling fan(s), drive belt(s), pulleys and exhaust system.
- Do not operate the engine indoors, but provide proper ventilation.
- Always return the engine idle speed to normal before disconnecting the exerciser tool.

1. With the ignition **OFF**, unplug the IAC motor wire connector at the throttle body.
2. Plug the exerciser tool No. 7558 harness connector onto the IAC motor (see refer to the accompanying illustration)
3. Connect the red clip of the exerciser tool to the positive battery terminal and the black clip to the negative terminal. The red lamp will be illuminated when it is properly connected.
4. Start the engine. When the switch is in the high or low position, the lamp on the exerciser tool will flash. This indicates that the voltage pulses are being sent to the IAC stepper motor.
5. Move the switch to the HIGH position. The engine speed should increase. Move the switch to the LOW position. The engine speed should decrease.
    a. If the engine speed changed predictably while using the exerciser tool,

Fig. 33 Remove the oxygen sensor with a flange wrench or appropriate socket—V6 engine shown

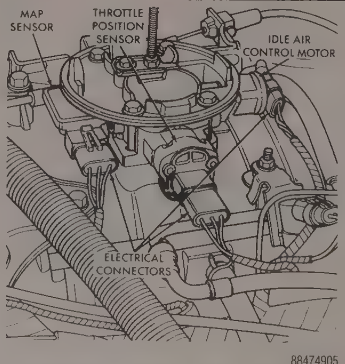


Fig. 34 The IAC motor—3.9L, 5.2L and 5.9L engines

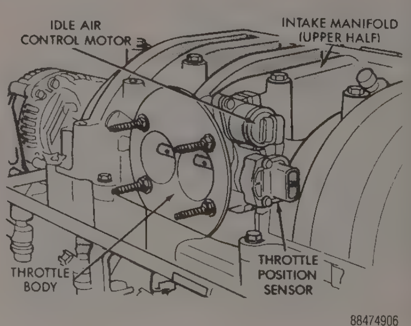


Fig. 35 Location of the IAC motor—8.0L engine

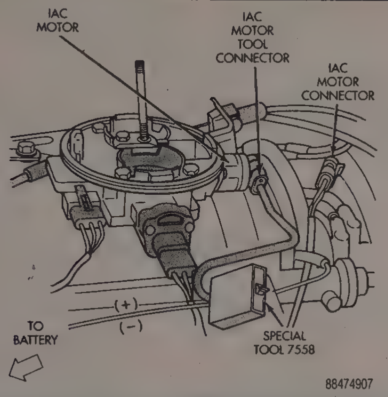

IAC MOTOR
IAC MOTOR TOOL CONNECTOR
IAC MOTOR CONNECTOR
(+)
(−)
TO BATTERY
SPECIAL TOOL 7558
88474907

Fig. 36 A typical hookup of the IAC motor exerciser tool No. 7558

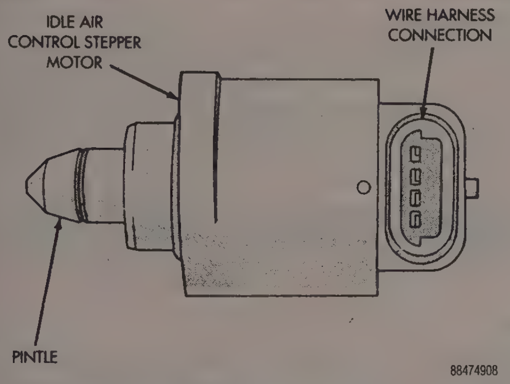

IDLE AIR CONTROL STEPPER MOTOR
WIRE HARNESS CONNECTION
PINTLE
88474908

Fig. 37 IAC stepper motor pintle

the IAC motor is working correctly. Disconnect the exerciser tool and connect the IAC stepper motor wire to the stepper motor.

b. If the engine speed does not change, turn the ignition **OFF** and proceed to the step No. 6. Do not disconnect the exerciser from the IAC stepper motor.

⁂ WARNING

With the IAC motor removed from the throttle body, do not extend the pintle more than 0.250 in. (6.35mm). If the pintle is extended more than this amount, it may separate from the IAC stepper motor and the motor will have to be replaced.

6. Remove the IAC stepper motor from the throttle body.
7. With the ignition **OFF**, cycle the exerciser tool switch between the HIGH and LOW positions. Keep your attention on the pintle. It should move in-and-out of the motor.

a. If the pintle does not move, replace the IAC motor. Start the engine and test the replacement motor operation as described in step No. 5.

b. If the pintle operates properly, check the IAC motor bore in the throttle body bore for blockage and clean as needed. Install the IAC motor and retest. If blockage is not found, more complete testing will be required using the DRBII scan tool, or equivalent and the appropriate Powertrain Diagnostics Procedures service manual.

REMOVAL & INSTALLATION

The IAC motor is mounted to the throttle body.

1. Remove the air cleaner housing and tube assembly.
2. Unplug the electrical connector from the IAC motor.
3. Remove the mounting bolts.
4. Remove the IAC motor from the throttle body.
5. Installation is the reverse of removal. Secure the bolts to 60 inch lbs. (7 Nm).

Coolant Temperature Sensor

OPERATION

See Figures 38 and 39

The engine coolant temperature sensor, located in the intake manifold near the thermostat housing, informs the computer when the coolant temperature reaches a predetermined operating level. Its signals to the computer also help to control the amount of spark advance with a cold engine.

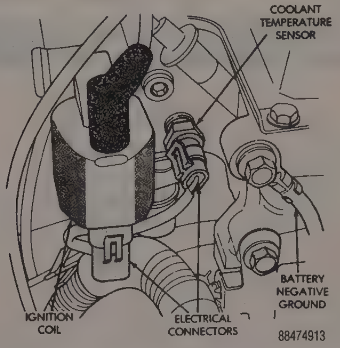

COOLANT TEMPERATURE SENSOR
BATTERY NEGATIVE GROUND
IGNITION COIL
ELECTRICAL CONNECTORS
88474913

Fig. 38 Location of the engine coolant temperature sensor—4-cylinder engine

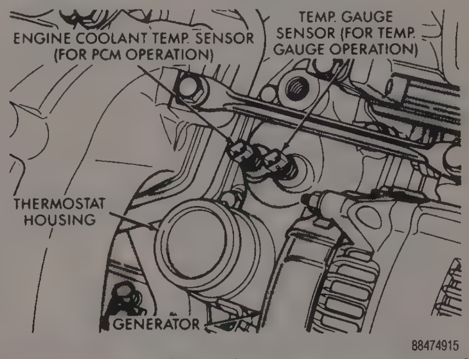

ENGINE COOLANT TEMP. SENSOR (FOR PCM OPERATION)
TEMP. GAUGE SENSOR (FOR TEMP. GAUGE OPERATION)
THERMOSTAT HOUSING
GENERATOR
88474915

Fig. 39 Location of the engine coolant temperature sensor—V10 engine

TESTING

1. Disengage the wire harness connector from the sensor.
2. Connect the leads of an ohmmeter to the terminals of the sensor.
3. With the engine cold and the ambient temperature less than 90°F (32°), the resistance should be between 500–1100 ohms.
4. With the engine at normal operating temperature, the resistance should be greater than 1300 ohms.

➡ **The sensor will continually change its resistance with a change in engine operating temperature.**

5. If the resistance is not within the specified ranges, replace the sensor.

REMOVAL & INSTALLATION

⁂ CAUTION

If the engine was previously in operation, do not attempt to drain the cooling system until the engine has had sufficient time to cool. Coolant reaches extremely high temperatures and can gush out of a hot system and scald you, causing severe injury.

The engine coolant temperature sensor is behind and below the engine thermostat on 2.5L engines, the intake manifold on V6 and V8 engines, and in the thermostat housing on the V10 engine.

1. Partially drain the cooling system to below the level of the coolant temperature sensor.
2. On V6 and V8 engine: Remove the air cleaner housing assembly.

➡On V6 and V8 engines with air conditioning, you may need to fabricate an 8 in. (20 cm) L-shaped hook tool from a coat hanger to pull the electrical connector. This connector is snapped into place, but not lock tab equipped.

3. Unplug the electrical connector, then unthread and remove the sensor.

Intake Manifold Air Temperature Sensor

OPERATION

➧ See Figures 40, 41 and 42

Found on V6, V8 and V10 engines, the intake manifold air temperature sensor is a variable, thermister type which reacts to temperature changes. In cold air, its resistance is high. As temperatures increase, its resistance decreases.

The sensor element itself extends into the intake manifold air stream to provide input voltage to the engine controller. This signal is used along with signals from other sensors by the engine controller to determine the fuel injector pulse width.

TESTING

This is a test of the sensor only. A complete test of the circuit requires the DRBII scan tool, or equivalent.

1. Unplug the wiring harness connector from the intake manifold temperature sensor.

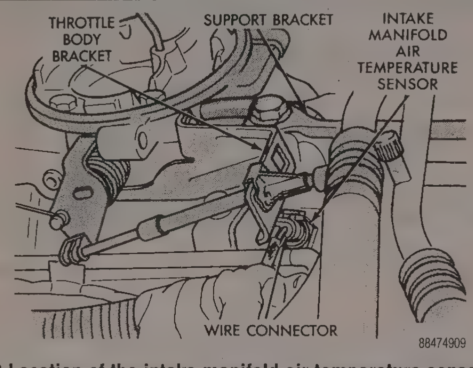


Fig. 40 Location of the intake manifold air temperature sensor—V6 engine

2. Using an input impedance volt-ohmmeter, measure across the terminals to test the resistance. The resistance should be less than 1340 ohms with the engine warm. Replace the sensor if not within specifications.
3. Test the resistance of the wire harness. Do this between the engine controller wire harness connector terminal 21 and the connector terminal. Also check between terminal 4 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

REMOVAL & INSTALLATION

1. Remove the air cleaner assembly.
2. Unplug the electrical connector at the sensor and unthread the sensor from the manifold.
3. Installation is the reverse of removal. Secure to 20 ft. lbs. (28 Nm).

Manifold Absolute Pressure (MAP) Sensor

OPERATION

The Manifold Absolute Pressure (MAP) sensor is a device which monitors manifold vacuum. It is either mounted on the firewall or throttle body and is linked electrically to the on-board computer. The MAP transmits information on manifold vacuum conditions to the computer. This data determines engine load and is used with data from other sensors to adjust the air/fuel mixture.

On the 2.5L engine, the MAP sensor is mounted in the right rear side of the engine compartment. It is connected to the throttle body by vacuum line. The MAP sensor on V6 and V8 engines is mounted to the throttle body. It is connected by an L-shaped rubber fitting. The V10 MAP sensor is found on the right side of the intake manifold and senses vacuum in the manifold.

TESTING

➧ See Figure 43

To completely test this sensor and its circuitry, you will need a DRBII scan tool, or equivalent. This is a test of the MAP sensor only. This test is for all engines except the 4-cylinder.

1. On the V6 and V8 engines: inspect the rubber fitting from the MAP sensor to the throttle body. Repair if necessary.
2. On the V6 and V8 engines: test the MAP sensor output voltage at the connector between terminals A and B (see drawing). With the ignition **ON** and the engine **OFF**, the output voltage should be 4–5 volts.
3. Test the engine controller terminal No. 1 for the same voltage to confirm that the wiring is in good shape. Repair if necessary.
4. Test the MAP sensor voltage at the sensor connector between terminals A and C with the ignition **ON**. The voltage should be 4.5–5.5 volts. Also check terminal No. 6 of the engine controller wiring harness for the same voltage. Repair or replace the wiring as necessary.
5. Test the engine controller pin-1 for the same voltage to verify the wire harness condition.

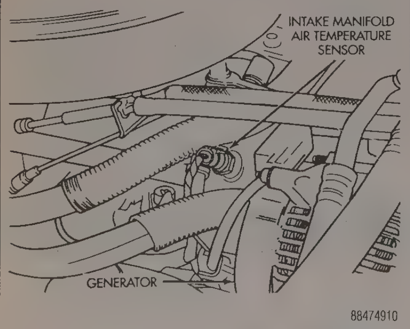


Fig. 41 Location of the intake manifold air temperature sensor—V8 engines

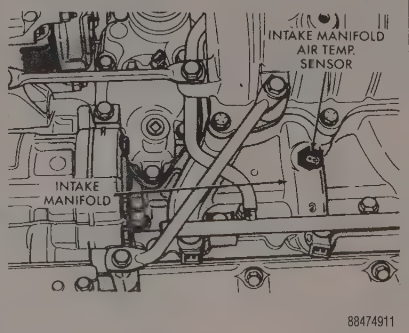


Fig. 42 Location of the intake manifold air temperature sensor—V10 engine

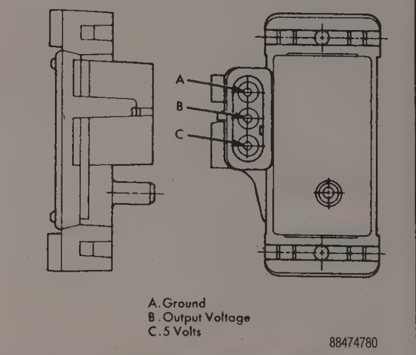


Fig. 43 Terminal connections for testing the MAP sensor

REMOVAL & INSTALLATION

2.5L Engine

1. Remove the vacuum hose and electrical connector from the sensor.
2. Remove the sensor mounting screws and remove the sensor.
3. Reverse the above procedure to install.

V6 and V8 Engines

1. Remove the air cleaner assembly and the tube.
2. Remove the throttle body.
3. Remove the MAP sensor mounting hardware.
4. While removing the sensor, slide the rubber L-shaped vacuum fitting from the throttle body fitting.
5. Remove the rubber L-shaped fitting from the MAP sensor.
6. Installation is the reverse of removal. Secure the MAP sensor mounting screws to 25 inch lbs. (3 Nm).

V10 Engine

1. Clean the area around the sensor before removal to keep debris out of the intake tract.
2. Remove the electrical connector.
3. Remove the sensor mounting bolts, then remove the sensor.
4. Installation is the reverse of removal. Secure the sensor bolts to 20 inch lbs. (2 Nm).

Throttle Position Sensor (TPS)

OPERATION

The Throttle Position Sensor (TPS) is located on the throttle body and tells the computer when the engine is at idle, off-idle, or at Wide-Open Throttle (WOT). At idle, the computer cancels the spark advance. Idle speed is computer-controlled through the automatic idle speed motor.

TESTING

To completely test this sensor and circuitry, you need the DRBII scan tool, or equivalent. This is a test of the sensor only. This test applies only to V6, V8 and V10 engines.

This test requires a digital voltmeter. The sensor must be checked on the vehicle with its 3-wire connector engaged to the sensor. The center terminal wire of the sensor connector is the output terminal.

1. Remove the air cleaner housing.
2. Attach the positive lead of the voltmeter to the center terminal of the sensor harness.
3. Attach the negative lead of the voltmeter to a good ground.
4. With the ignition key in the **ON** position and engine not running, check the sensor output voltage at the center terminal wire of the connector. Check this at idle (throttle plate closed) and at Wide Open Throttle (WOT). At idle, the sensor output voltage should be greater than 200 millivolts. At WOT, the sensor output voltage should be less than 4.8 volts. The output voltage should increase gradually as the throttle plate is slowly opened from idle to WOT.
5. If the sensor does not meet specifications, replace it.

REMOVAL & INSTALLATION

➧ See Figures 44, 45, 46 and 47

1. Remove the air cleaner housing assembly.
2. Unplug the TPS electrical connector, remove the two bolts.
3. Remove the TPS from the throttle body.
4. Installation is the reverse of removal.

➡The throttle shaft end of the throttle body slides into the socket in the TPS. The TPS must be installed so it can be rotated a few degrees. If the sensor will not rotate, install the sensor with the throttle shaft on the other side of the socket tangs. The TPS will be under slight tension when rotated.

5. Install the TPS and its retaining bolts tightening to 60 inch lbs. (7 Nm).

Fig. 44 Unbolt and remove the throttle position sensor from the throttle body

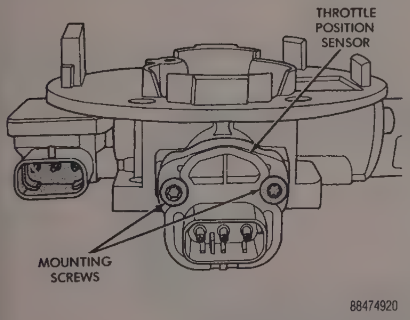


Fig. 45 Mount the TPS as shown—V6 and V8 engines

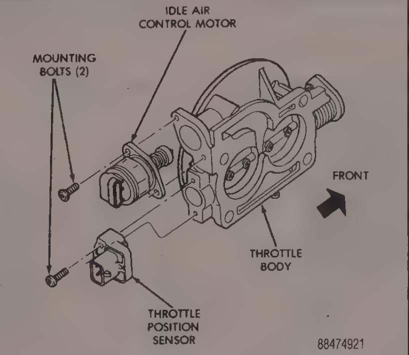


Fig. 46 Exploded view of the TPS mounting—V10 engine

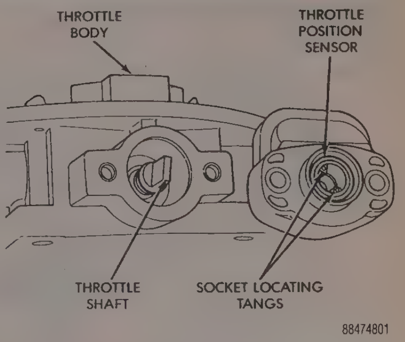


Fig. 47 Align the locating tangs on the TPS with the throttle shaft

Camshaft Position Sensor

OPERATION

▶ See Figures 48 and 49

The camshaft position sensor is required for all vehicles that utilize a sequential multi-port fuel injection system. It serves this system by providing a fuel sync signal to the engine controller. The sync signal is used in conjunction with the signal sent by the crankshaft signal to maintain the correct injector firing order. On V6 and V8 engines, the camshaft position sensor is located in the distributor. On V10 engines, the camshaft position sensor is found in the timing chain case/cover on the left-front side of the engine.

TESTING

4-Cylinder, V6 and V8 Engines

To completely test this sensor and circuitry, you need the DRBII scan tool, or equivalent. This is a test of the camshaft position sensor only.

For this test you will need an analog (non-digital) voltmeter. Do not remove the distributor connector. Using small paper clips, insert them into the backside of the distributor wire harness connector to make contact with the terminals. Do not damage the connector when inserting the paper clips. Attach the voltmeter leads to these clips.

1. Connect the positive voltmeter lead to the sensor output wire. This is done at the distributor wire harness connector.
2. Connect the negative voltmeter lead to the ground wire.
3. Set the voltmeter to the 15 volt (or 20 volt) DC scale.
4. Remove the distributor cap and crank the engine. On 4-cylinder engines, rotate the engine until the rotor is pointed to approximately the 11:00 o'clock position. On V6 and V8 engines, rotate the engine until the distributor rotor is pointed towards the rear of the vehicle. The moveable pulse ring should now be within the camshaft position sensor pickup.
5. Turn the ignition **ON**. The voltmeter reading should read approximately 5.0 volts. If there is no voltage reading, check the meter connections.
6. If voltage is still not present, check for voltage at the supply wire.

➡Refer to the engine controller pin connection charts when performing these test procedures.

7. If 5.0 volts is not found at the supply wire, check for voltage at pin-7 of the engine controller 60-way connector (1994–95 models) or cavity A-17 of the 32-way connector (1996 only). Leave the engine controller harness connected for this test.

➡If voltage is not found at the PCM connector, you will need to diagnose the system using a DRBII scan tool, or equivalent, or take the vehicle to a qualified shop.

8. If voltage is present at the engine controller connector, but not the supply wire:
   a. Check continuity between the supply wire. This is checked between the distributor connector and pin-7 (1994–95 models) or cavity A-17 (1996 only). If continuity is not present, repair the wire harness.
   b. Check for continuity between the camshaft position sensor output wire and pin-44 (1994–95 models) or cavity A-18 (1996 models) at the engine controller. If continuity is not present, repair the wire harness.
   c. Check for continuity between the ground circuit wire at the distributor connector and ground. If continuity is not present, repair the wire harness.
9. Crank the engine while observing the voltmeter. The voltmeter needle should fluctuate 0–5 volts. This will verify the camshaft position sensor is operating properly and a sync pulse signal is being generated.
10. If a sync pulse signal is not detected, and all other variables have been eliminated, replace the camshaft position sensor.

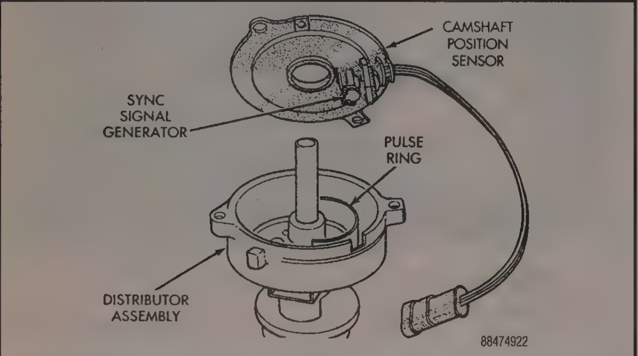


Fig. 48 Exploded view of the camshaft position sensor mounting—4-cylinder, V6 and V8 engines

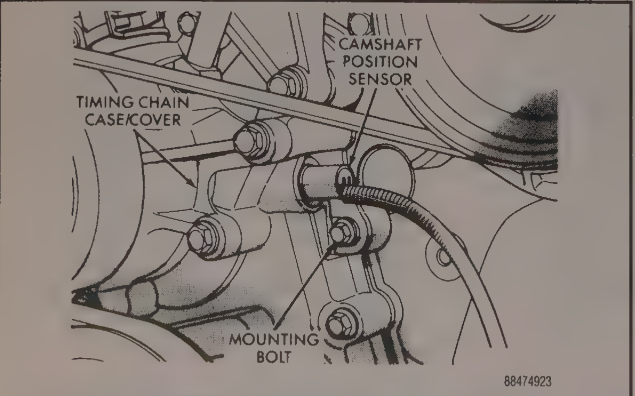


Fig. 49 Camshaft position sensor mounting—V10 engine

V10 Engine

▶ See Figure 50

The only test you can perform without a DRBII scan tool, or its equivalent, is a basic check of the sensor only.

1. Near the rear of the intake manifold, unplug the sensor pigtail harness connector from the main wire harness connector.
2. Set the ohmmeter to the 1K–10K scale. Place the ohmmeter leads across terminals B and C (see drawing). The meter reading should be open (infinite resistance). If a low resistance is read, replace the camshaft position sensor.

REMOVAL & INSTALLATION

4-Cylinder, V6 and V8 Engines

▶ See Figure 48

1. On V6 and V8 engines, remove the air cleaner assembly.
2. Disconnect the negative battery cable.
3. Remove the distributor cap and unplug the camshaft position sensor wire.
4. Remove the rotor from the shaft, then lift the camshaft position sensor assembly from the distributor.
5. Installation is the reverse of removal.

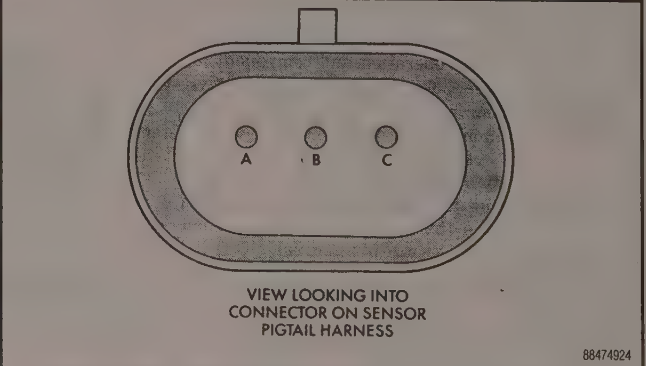


Fig. 50 End view of the camshaft position sensor connector and terminal identification—8.0L engine

V10 Engine

See Figure 49

A thin plastic rib is molded into the face of the camshaft position sensor to position the depth of the sensor to the upper cam gear (sprocket). This rib is found on original and replacement sensors. The first time the engine is operated with the new sensor, part of the rib may be sheared (ground) off. Depending on parts tolerances, some of the plastic rib may still be observed after removal.

SENSOR REPLACEMENT—OLD SENSOR

This procedure will require a special peel-and-stick paper spacer of a calibrated thickness for setting the tolerance of the sensor upon installation. This special paper should be available from the dealer parts department.

If the original camshaft position sensor is to be removed and installed, such as when servicing the timing chain, timing gears or timing chain cover, use this procedure.

1. Unplug the sensor harness connector from the engine harness.
2. Remove the sensor mounting bolt.
3. Carefully pry the sensor from the timing chain case/cover in a rocking action with two small prytools.
4. Remove the sensor. Check the condition of the sensor O-ring.

To install:

When installing a used camshaft position sensor, the depth must be adjusted.

5. Inspect the face of the sensor. If any of the original rib material remains, cut it flush to the face of the sensor with a razor knife. Remove only enough of the rib material until the face is flat.

**** WARNING**

Do not remove more rib material than necessary or damage to the sensor may result. Never use an electric grinder to remove rib material, as the magnetic field from the electric motor may cause electrical damage to the sensor.

6. Apply the special peel-and-stick paper spacer to the (clean and flat) face of the sensor.
7. Apply a small amount of clean engine oil to the O-ring.
8. Using a slight rocking action, install the sensor into the timing case/cover until the paper spacer just contacts the gear. Do not twist the sensor or you may tear the paper or O-ring. Do not install the mounting bolt.
9. Use a scribe to scratch a line into the timing case/cover to indicate the depth of the sensor, then remove the sensor.
10. Remove the paper spacer so it will not remain in the engine and get lost in the engine oil passages.
11. Again, apply a small amount of oil to the sensor O-ring and install the sensor until it aligns with the scribe mark.
12. Install the mounting bolt, tightening it to 50 inch lbs. (6 Nm).
13. Plug-in the engine wire harness connector to the sensor connector.

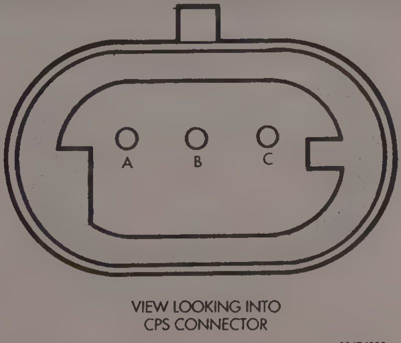


Fig. 51 End view of the crankshaft position sensor connector and terminal identification—2.5L engine

SENSOR REPLACEMENT—NEW SENSOR

Use this procedure if a NEW camshaft position sensor is to be installed.

1. Unplug the wire connectors and unbolt the sensor.
2. Carefully pry the sensor from the timing chain case/cover in a rocking action with two small prytools.
3. Remove the sensor. Check the condition of the sensor O-ring.
4. Installation is the reverse of removal. Lightly lubricate the O-ring with fresh engine oil.
5. Using a slight rocking action, install the sensor into the timing case/cover until the paper spacer just contacts the gear. Do not twist the sensor or you may tear the O-ring. Push the sensor all the way into the cover until the rib material on the sensor contacts the camshaft gear.
6. Install the mounting bolt, tightening it to 50 inch lbs. (6 Nm).

Crankshaft Position Sensor

OPERATION

The crankshaft position sensor is found on 1992–96 V6 and V8 engines, as well as on the 1994–96 V10 engines, and 1996 2.5L 4-cylinder models. The sensor generates pulses and sends them to the engine controller. The controller interprets this input signal to determine the crankshaft position (and engine speed). With this and other information, the engine controller determines injector sequence and ignition timing. The sensor is a hall effect device combined with an internal magnet. It is sensitive to steel within a certain distance from it.

On the 4-cylinder engine the crankshaft position sensor is mounted to the transmission bell housing. On the V6 and V8 engines, the crankshaft position sensor is bolted to the cylinder block near the rear of the right cylinder head. On the V10 engine, the crankshaft position sensor is located on the right-lower side of the cylinder block, just above the oil pan rail.

TESTING

See Figure 51

The only test you can perform without a DRBII scan tool, or equivalent, is a basic check of the sensor only.

1. Near the rear of the intake manifold, unplug the sensor pigtail harness connector from the main wire harness connector.
2. Set the ohmmeter to the 1K–10K scale. Place an ohmmeter across terminals B and C (see the illustration). The meter reading should be open (infinite resistance). If a low resistance is read, replace the camshaft position sensor.

REMOVAL & INSTALLATION

2.5L Engine

See Figure 52

1. Near the rear of the intake manifold, disconnect the pigtail harness from the sensor.
2. Remove the nut holding the sensor wire clip to the fuel rail mounting stud.

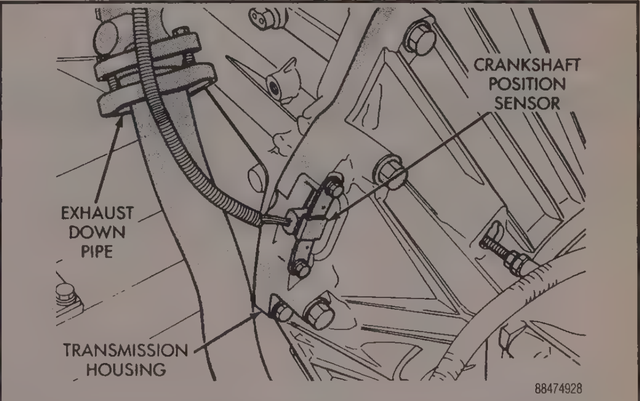


Fig. 52 Crankshaft position sensor location—4-cylinder engine

3. Remove the sensor mounting hardware, then the sensor.
4. Remove the clip from the sensor wire harness.
5. Installation is the reverse of removal. Secure the bolts or nuts to 14 ft. lbs. (19 Nm).

V6 and V8 engines

See Figure 53

1. Remove the air cleaner assembly.
2. Unplug the wire from the sensor.
3. Unbolt then remove the sensor from the engine.
4. Installation is the reverse of removal. Secure the mounting bolts to 70 inch lbs. (8 Nm).
5. Install the air cleaner assembly.

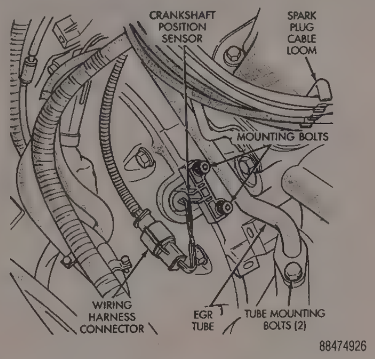


Fig. 53 Crankshaft position sensor location—V6 and V8 engines

V10 Engine

See Figure 54

1. Raise and safely support the vehicle.
2. Unplug the sensor harness connector from the engine harness.
3. Remove the sensor mounting bolt.
4. Carefully pry the sensor from the timing chain case/cover in a rocking action with two small prytools.
5. Remove the sensor. Check the condition of the sensor O-ring.
6. Installation is the reverse of removal. Apply a small amount of fresh engine oil to the sensor O-ring.
7. Install the mounting bolt, tightening it to 70 inch lbs. (8 Nm).

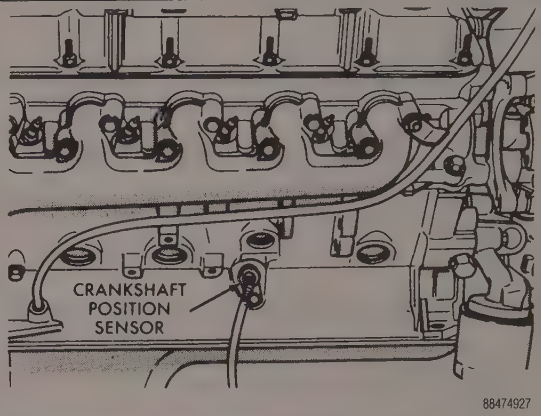


Fig. 54 Crankshaft position sensor location—V10 engine

DIAGNOSTIC TROUBLE CODES (DTCS)

General Information

The engine controller monitors critical input and output circuits, making sure they are operational. Some circuits are checked continuously, and some are checked only under certain conditions.

Integrated into the engine controller is the On-Board Diagnostic (OBD) system. If the OBD system detects a bad circuit, it will store a DTC into memory. Each fault detected is assigned a specific code (see listing of DTCs). The code will stay as long as the circuit is perceived to have a problem. If the problem does not occur again, the memory will clear after fifty engine start-ups.

The DTC's are read via the malfunction indicator lamp (CHECK ENGINE lamp). A DTC description can also be provided by the professional DRBII scan tool, or equivalent.

A DTC is a general guide to point the diagnosing technician in the right direction of a problem in the engine management system. The OBD system monitors whole circuits, not individual components within the circuits. Thus, a DTC does not identify which component of a given circuit has failed and so it is to be treated as a symptom that may or may not be a real problem. In some cases, because of the design of the diagnostic test procedure, a DTC can be the reason for another DTC to be set. Thus it is vital that a systematic (process-of-elimination) troubleshooting procedure be followed.

Data Link Connector

The data link connector is a dedicated diagnostic scan tool connector. It is located in the engine compartment against the fire wall. It links the engine controller to the Diagnostic Readout Box (DRBII) scan tool or the Mopar Diagnostic System (MDS), or any other Chrysler-compatible diagnostic scan tool.

Reading Diagnostic Trouble Codes

When the CHECK ENGINE light comes on and stays on (after start-up), this indicates that a code (or codes) has been stored in memory. To retrieve this information for purposes of troubleshooting, cycle the ignition switch **ON-OFF-ON-OFF-ON** within five seconds. The check engine lamp will then flash the DTC(s). Each code, if there is more than one, will be preceded by a four second pause, to distinguish it from the previous code. An example of a DTC would be as follows:

- Lamp on for two seconds, then turns off.
- Lamp flashes four times, then pauses, then flashes one time.
- Lamp pauses four seconds, then flashes four times
- Lamp flashes seven times.

The two DTC's displayed, following the two second pause, were 41 and 47. Whenever the malfunction indicator is operated, as many DTC's as are in memory will be displayed. At the end of the sequence, it will flash 55, which indicates it is the end of the stored codes.

Clearing Diagnostic Trouble Codes

When a problem has been sorted out and repaired, you will have to erase the DTC(s) from memory to shut off the CHECK ENGINE LIGHT. The proper way to erase a DTC is with the DRBII scan tool, or equivalent. If you do not have access to this tool you will have to take the vehicle to a shop that does. If the cause for the blown trouble code is indeed repaired, the memory will automatically be cleared by the engine controller after fifty start-ups.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
11*	No Crank Reference Signal at PCM	No crank reference signal detected during engine cranking.
12*	None	Direct battery input to PCM was disconnected within the last 50 Key-on cycles.
13**	No Change in MAP From Start to Run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading at start-up.
14**	MAP Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
	or	
	MAP Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

88474C70

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS—CONTINUED

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
15**	No Vehicle Speed Sensor Signal	No vehicle distance (speed) sensor signal detected during road load conditions.
17*	Engine is Cold Too Long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (thermostat).
21**	O2S Stays at Center	Neither rich or lean condition detected from the oxygen sensor input. If equipped with dual O2S sensors, the DRB scan tool will specify left or right sensor.
	or	
	O2S Shorted to Voltage	Oxygen sensor input voltage maintained above the normal operating range. If equipped with dual O2S sensors, the DRB scan tool will specify left or right sensor.
22**	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above maximum acceptable voltage.
	or	
	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below minimum acceptable voltage.
23**	Intake Air Temp Sensor Voltage Low	Intake manifold air temperature sensor input below the minimum acceptable voltage.
	or	
	Intake Air Temp Sensor Voltage High	Intake manifold air temperature sensor input above the maximum acceptable voltage.
24**	Throttle Position Sensor Voltage High	Throttle position sensor input above the maximum acceptable voltage.
	or	
	Throttle Position Sensor Voltage Low	Throttle position sensor input below the minimum acceptable voltage.
25**	Idle Air Control Motor Circuits	A shorted condition detected in one or more of the idle air control motor circuits.
27*	Injector #1 Control Circuit	Injector #1 output driver does not respond properly to the control signal.
	or	
	Injector #2 Control Circuit	Injector #2 output driver does not respond properly to the control signal.
	or	

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

88474C71

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS—CONTINUED

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
	Injector #3 Control Circuit	Injector #3 output driver does not respond properly to the control signal.
	or	
	Injector #4 Control Circuit	Injector #4 output driver does not respond properly to the control signal.
	or	
	Injector #5 Control Circuit	Injector #5 output driver does not respond properly to the control signal.
	or	
	Injector #6 Control Circuit	Injector #6 output driver does not respond properly to the control signal.
	or	
	Injector #7 Control Circuit	Injector #7 output driver does not respond properly to the control signal.
	or	
	Injector #8 Control Circuit	Injector #8 output driver does not respond properly to the control signal.
31**	EVAP Solenoid Circuit	An open or shorted condition detected in the EVAP solenoid circuit.
32**	EGR Solenoid Circuit	An open or shorted condition detected in the EGR solenoid circuit.
	or	
	EGR System Failure	A mechanical problem found in EGR system (vacuum line leak, defective EGR valve, plugged EGR tube, etc.).
33*	A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay circuit.
34*	Speed Control Solenoid Circuits	An open or shorted condition detected in the Speed Control vacuum or vent solenoid circuits.
	or	
	Speed Control Switch Always Low	Speed Control switch input below the minimum acceptable voltage.
	or	
	Speed Control Switch Always High	Speed Control switch input above the maximum acceptable voltage.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

88474C72

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS—CONTINUED

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
37**	Torque Converter Clutch Solenoid CKT	An open or shorted condition detected in the CKT circuit.
	or	
	Trans Temp Sensor Voltage Too Low	Voltage Low at Trans Temp Sensor
	or	
	Trans Temp Sensor Voltage Too High	Voltage High at Trans Temp Sensor
41**	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
42*	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
43**	Ignition Coil Circuit #1	An open or shorted condition detected in the #1 coil circuit.
	or	
	Ignition Coil Circuit #2	An open or shorted condition detected in the #2 coil circuit.
	or	
	Ignition Coil Circuit #3	An open or shorted condition detected in the #3 coil circuit.
	or	
	Ignition Coil Circuit #4	An open or shorted condition detected in the #4 coil circuit.
	or	
	Ignition Coil Circuit #5	An open or shorted condition detected in the #5 coil circuit.
44*	Battery Temp Sensor Volts out of Limit	An open or shorted condition exists in the engine coolant temperature sensor circuit or a problem exists in the PCM's battery temperature voltage circuit.
45*	Trans Overdrive Solenoid Circuit	An open or shorted condition exists in the transmission overdrive solenoid circuit.
46**	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
47**	Charging System Voltage Too Low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of generator output.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

88474C73

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS—CONTINUED

Diagnostic Trouble Code	DRB Scan Tool Display	Description of Diagnostic Trouble Code
51**	System Lean L-Idle Adap at Rich Limit	Oxygen sensor signal input indicates lean air/fuel ratio condition at the left O2S sensor during engine operation. If equipped with dual O2S sensors, the DRB scan tool will specify left or right sensor.
	or	
	System Lean R-Idle Adap at Rich Limit	Oxygen sensor signal input indicates lean air/fuel ratio condition at the right O2S sensor during engine operation. If equipped with dual O2S sensors, the DRB scan tool will specify left or right sensor.
52**	System Rich L-Idle Adap at Lean Limit	Oxygen sensor signal input indicates rich air/fuel ratio condition at the left O2S sensor during engine operation. If equipped with dual O2S sensors, the DRB scan tool will specify left or right sensor.
	or	
	System Rich R-Idle Adap at Lean Limit	Oxygen sensor signal input indicates rich air/fuel ratio condition at the right O2S sensor during engine operation. If equipped with dual O2S sensors, the DRB scan tool will specify left or right sensor.
53*	Internal PCM Failure	PCM Internal fault condition detected.
	or	
	PCM Failure SPI (Serial Peripheral Interface) Communications	PCM Internal fault condition detected.
54*	No Cam Sync Signal at PCM	No fuel sync (camshaft signal) detected during engine cranking.
55*	Display not shown on DRB scan tool	A DTC #55 is used to end all DTC messages. This code indicates a completion of all DTC's displayed on the Malfunction Indicator Lamp (Check Engine Lamp).
62*	PCM Failure SRI miles not stored	Unsuccessful attempt to update SRI (service reminder indicator) miles in the PCM EEPROM.
63*	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the PCM.

* Check Engine Lamp will not illuminate at all times if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

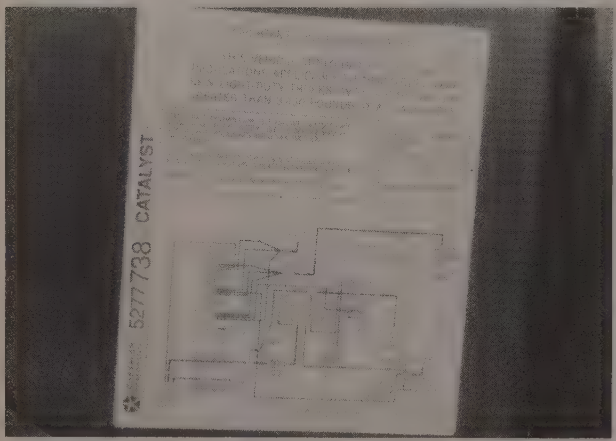
** Check Engine Lamp will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

88474C74

VACUUM DIAGRAMS

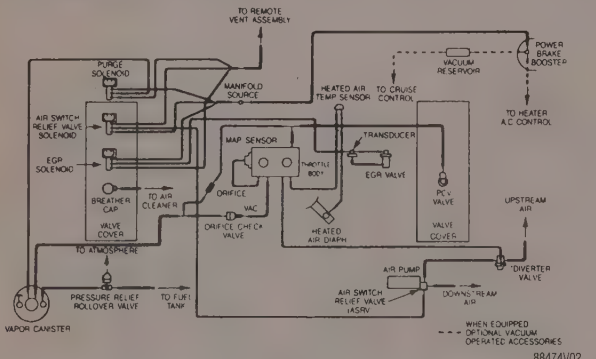
Following are vacuum diagrams for most of the engine and emissions package combinations covered by this manual. Because vacuum circuits will vary based on various engine and vehicle options, always refer first to the vehicle emission control information label, if present. Should the label be missing, or should the vehicle be equipped with a different engine from the vehicle's original equipment, refer to the diagrams below for the same or similar configuration.

If you wish to obtain a replacement emissions label, most manufacturers make the labels available for purchase. The labels can usually be ordered from a local dealer.


5277738 CATALYST

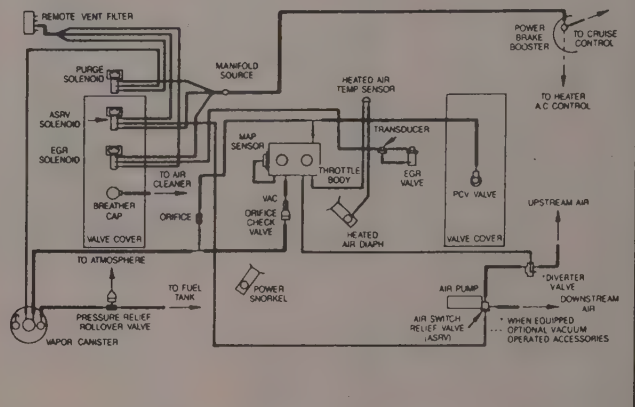
88474P00

Fig. 55 All vehicles should be equipped with a label comparable to the one shown


TO REMOTE VENT ASSEMBLY
PURGE SOLENOID
MANIFOLD SOURCE
HEATED AIR TEMP SENSOR
TO CRUISE CONTROL
VACUUM RESERVOIR
POWER BRAKE BOOSTER
TO HEATER A.C CONTROL
AIR SWITCH RELIEF VALVE SOLENOID
EGR SOLENOID
MAP SENSOR
TRANSDUCER
THROTTLE BODY
EGR VALVE
BREATHER CAP
TO AIR CLEANER
ORIFICE
VAC
ORIFICE CHECK VALVE
PCV VALVE
VALVE COVER
HEATED AIR DIAPH
VALVE COVER
UPSTREAM AIR
TO ATMOSPHERE
AIR PUMP
*DIVERTER VALVE
AIR SWITCH RELIEF VALVE (ASRV)
DOWNSTREAM AIR
PRESSURE RELIEF ROLLOVER VALVE
TO FUEL TANK
VAPOR CANISTER
* WHEN EQUIPPED
- - - OPTIONAL VACUUM OPERATED ACCESSORIES

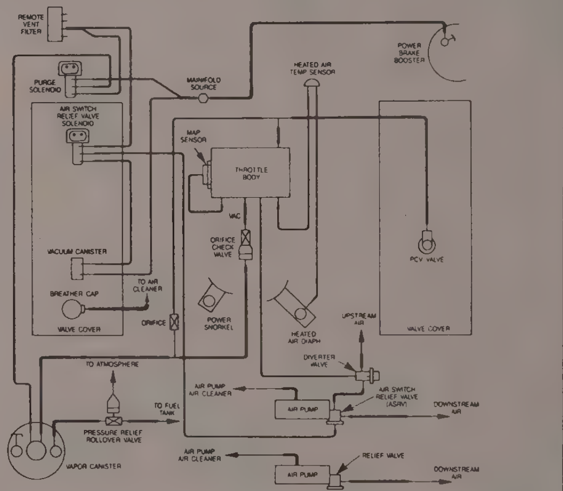
88474V02

Fig. 56 Vacuum hose routing—1989–90 3.9L engine


REMOTE VENT FILTER
POWER BRAKE BOOSTER
TO CRUISE CONTROL
PURGE SOLENOID
MANIFOLD SOURCE
HEATED AIR TEMP SENSOR
TO HEATER A.C CONTROL
ASRV SOLENOID
EGR SOLENOID
MAP SENSOR
TRANSDUCER
THROTTLE BODY
EGR VALVE
TO AIR CLEANER
BREATHER CAP
ORIFICE
VAC
ORIFICE CHECK VALVE
PCV VALVE
UPSTREAM AIR
VALVE COVER
HEATED AIR DIAPH
VALVE COVER
TO ATMOSPHERE
TO FUEL TANK
POWER SNORKEL
AIR PUMP
*DIVERTER VALVE
DOWNSTREAM AIR
PRESSURE RELIEF ROLLOVER VALVE
AIR SWITCH RELIEF VALVE (ASRV)
VAPOR CANISTER
* WHEN EQUIPPED
--- OPTIONAL VACUUM OPERATED ACCESSORIES

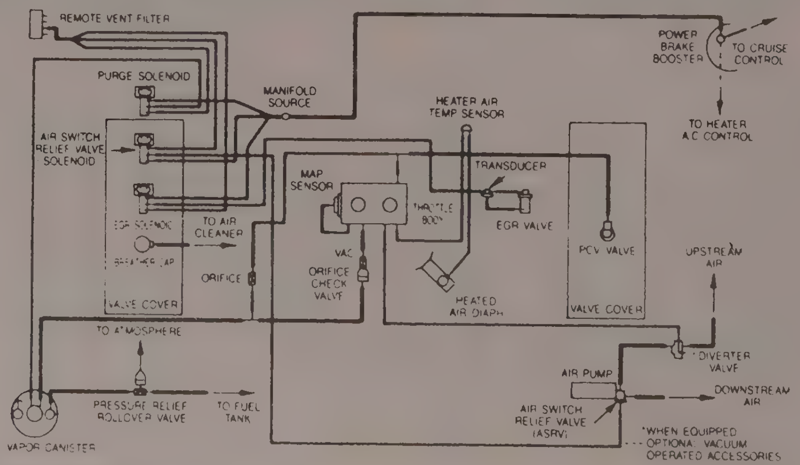
88474V04

Fig. 58 Vacuum hose routing—1989–90 5.9L light duty Federal, Canadian, and High Altitude engines


REMOTE VENT FILTER
POWER BRAKE BOOSTER
HEATED AIR TEMP SENSOR
PURGE SOLENOID
MANIFOLD SOURCE
AIR SWITCH RELIEF VALVE SOLENOID
MAP SENSOR
THROTTLE BODY
VAC
ORIFICE CHECK VALVE
PCV VALVE
VACUUM CANISTER
TO AIR CLEANER
BREATHER CAP
ORIFICE
POWER SNORKEL
HEATED AIR DIAPH
UPSTREAM AIR
VALVE COVER
VALVE COVER
DIVERTER VALVE
TO ATMOSPHERE
AIR PUMP AIR CLEANER
AIR SWITCH RELIEF VALVE (ASRV)
AIR PUMP
DOWNSTREAM AIR
TO FUEL TANK
PRESSURE RELIEF ROLLOVER VALVE
AIR PUMP AIR CLEANER
RELIEF VALVE
AIR PUMP
DOWNSTREAM AIR
VAPOR CANISTER

88474V05

Fig. 59 Vacuum hose routing—1989–90 5.9L heavy duty engine without EGR solenoid


REMOTE VENT FILTER
POWER BRAKE BOOSTER
TO CRUISE CONTROL
PURGE SOLENOID
MANIFOLD SOURCE
HEATER AIR TEMP SENSOR
TO HEATER A.C CONTROL
AIR SWITCH RELIEF VALVE SOLENOID
TRANSDUCER
MAP SENSOR
THROTTLE BODY
EGR SOLENOID
TO AIR CLEANER
EGR VALVE
BREATHER CAP
PCV VALVE
UPSTREAM AIR
ORIFICE
VAC
ORIFICE CHECK VALVE
HEATED AIR DIAPH
VALVE COVER
VALVE COVER
TO ATMOSPHERE
*DIVERTER VALVE
AIR PUMP
DOWNSTREAM AIR
PRESSURE RELIEF ROLLOVER VALVE
TO FUEL TANK
AIR SWITCH RELIEF VALVE (ASRV)
VAPOR CANISTER
*WHEN EQUIPPED
--- OPTIONAL VACUUM OPERATED ACCESSORIES

88474V03

Fig. 57 Vacuum hose routing—1989–90 5.2L engine

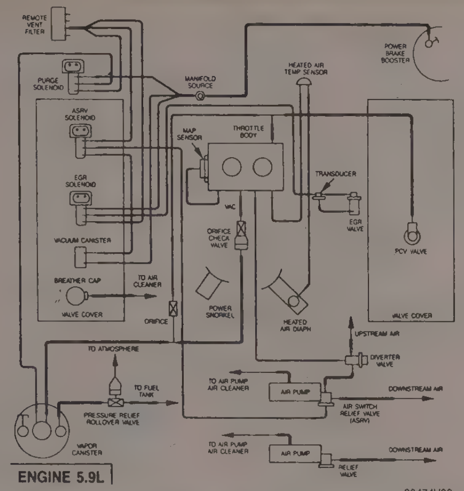

REMOTE VENT FILTER
POWER BRAKE BOOSTER
HEATED AIR TEMP SENSOR
PURGE SOLENOID
MANIFOLD SOURCE
ASRV SOLENOID
MAP SENSOR
THROTTLE BODY
TRANSDUCER
EGR SOLENOID
VAC
ORIFICE CHECA VALVE
EGR VALVE
PCV VALVE
VACUUM CANISTER
BREATHER CAP
TO AIR CLEANER
VALVE COVER
ORIFICE
POWER SNORKEL
HEATED AIR DIAPH
VALVE COVER
UPSTREAM AIR
TO ATMOSPHERE
DIVERTER VALVE
TO FUEL TANK
TO AIR PUMP AIR CLEANER
AIR PUMP
DOWNSTREAM AIR
PRESSURE RELIEF ROLLOVER VALVE
AIR SWITCH RELIEF VALVE (ASRV)
VAPOR CANISTER
TO AIR PUMP AIR CLEANER
AIR PUMP
DOWNSTREAM AIR
RELIEF VALVE
ENGINE 5.9L
88474V06

Fig. 60 Vacuum hose routing—1989–90 5.9L heavy duty Federal, California and Canadian engines

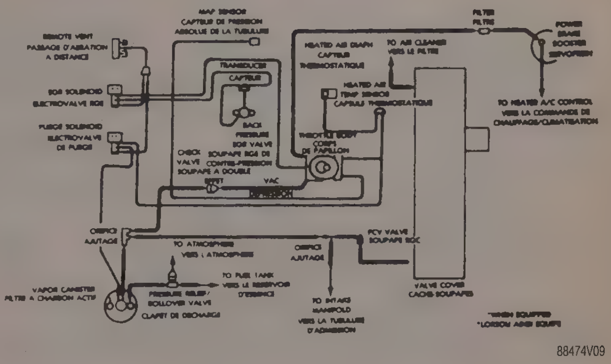

MAP SENSOR
CAPTEUR DE PRESSION ABSOLUE DE LA TUBULURE
FILTER
FILTRE
POWER BRAKE BOOSTER
SERVOFREIN
REMOTE VENT
PASSAGE D'AERATION A DISTANCE
HEATED AIR DIAPH
CAPTEUR THERMOSTATIQUE
TO AIR CLEANER
VERS LE FILTRE
TRANSDUCER
CAPTEUR
EGR SOLENOID
ELECTROVALVE EGR
HEATED AIR TEMP SENSOR
CAPTEUR THERMOSTATIQUE
TO HEATER A/C CONTROL
VERS LA COMMANDE DE CHAUFFAGE/CLIMATISATION
PURGE SOLENOID
ELECTROVALVE DE PURGE
BACK PRESSURE EGR VALVE
SOUPAPE EGR DE CONTRE-PRESSION
THROTTLE BODY
CORPS DE PAPILLON
CHECK VALVE
SOUPAPE A DOUBLE
VAC
ORIFICE
AJUTAGE
PCV VALVE
SOUPAPE RGC
TO ATMOSPHERE
VERS L'ATMOSPHERE
ORIFICE
AJUTAGE
VAPOR CANISTER
FILTRE A CHARBON ACTIF
TO FUEL TANK
VERS LE RESERVOIR D'ESSENCE
PRESSURE RELIEF/ ROLLOVER VALVE
CLAPET DE DECHARGE
TO INTAKE MANIFOLD
VERS LA TUBULURE D'ADMISSION
VALVE COVER
CACHE-SOUPAPES
*WHEN EQUIPPED
*LORSQU'AINSI EQUIPE
88474V09

Fig. 63 Vacuum hose routing—1991–93 Canadian 2.5L engine

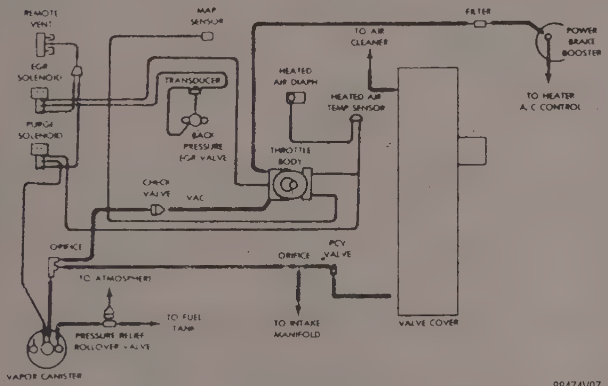

REMOTE VENT
MAP SENSOR
FILTER
TO AIR CLEANER
POWER BRAKE BOOSTER
EGR SOLENOID
TRANSDUCER
HEATED AIR DIAPH
HEATED AIR TEMP SENSOR
TO HEATER A/C CONTROL
PURGE SOLENOID
BACK PRESSURE EGR VALVE
THROTTLE BODY
CHECK VALVE
VAC
ORIFICE
ORIFICE
PCV VALVE
TO ATMOSPHERE
TO FUEL TANK
PRESSURE RELIEF ROLLOVER VALVE
TO INTAKE MANIFOLD
VALVE COVER
VAPOR CANISTER
88474V07

Fig. 61 Vacuum hose routing—1991–93 Federal 2.5L engine

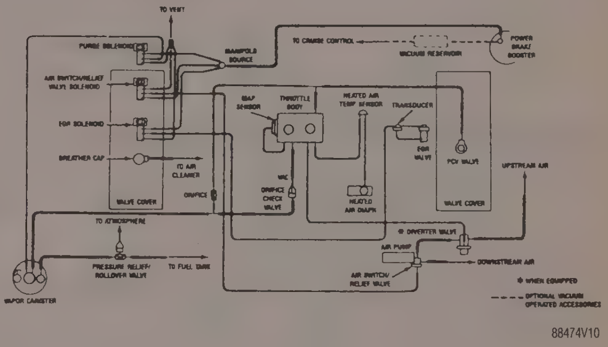

TO VENT
PURGE SOLENOID
MANIFOLD SOURCE
TO CRUISE CONTROL
VACUUM RESERVOIR
POWER BRAKE BOOSTER
AIR SWITCH/RELIEF VALVE SOLENOID
MAP SENSOR
THROTTLE BODY
HEATED AIR TEMP SENSOR
TRANSDUCER
EGR SOLENOID
EGR VALVE
PCV VALVE
BREATHER CAP
TO AIR CLEANER
UPSTREAM AIR
VAC
ORIFICE
ORIFICE CHECK VALVE
HEATED AIR DIAPH
VALVE COVER
VALVE COVER
TO ATMOSPHERE
* DIVERTER VALVE
AIR PUMP
DOWNSTREAM AIR
PRESSURE RELIEF/ ROLLOVER VALVE
TO FUEL TANK
AIR SWITCH/ RELIEF VALVE
VAPOR CANISTER
* WHEN EQUIPPED
OPTIONAL VACUUM OPERATED ACCESSORIES
88474V10

Fig. 64 Vacuum hose routing—1991 Federal 3.9L engine

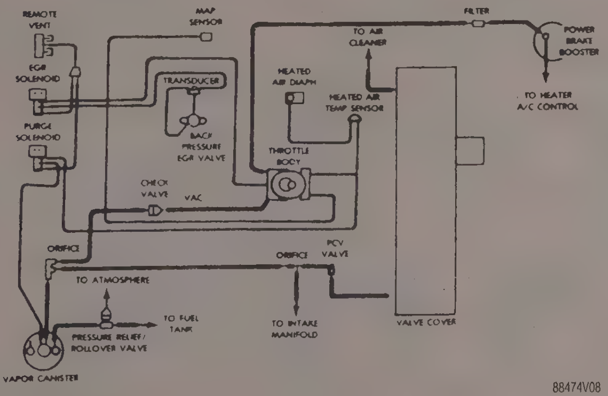

REMOTE VENT
MAP SENSOR
FILTER
TO AIR CLEANER
POWER BRAKE BOOSTER
EGR SOLENOID
TRANSDUCER
HEATED AIR DIAPH
HEATED AIR TEMP SENSOR
TO HEATER A/C CONTROL
PURGE SOLENOID
BACK PRESSURE EGR VALVE
THROTTLE BODY
CHECK VALVE
VAC
ORIFICE
ORIFICE
PCV VALVE
TO ATMOSPHERE
TO FUEL TANK
PRESSURE RELIEF/ ROLLOVER VALVE
TO INTAKE MANIFOLD
VALVE COVER
VAPOR CANISTER
88474V08

Fig. 62 Vacuum hose routing—1991–93 California 2.5L engine

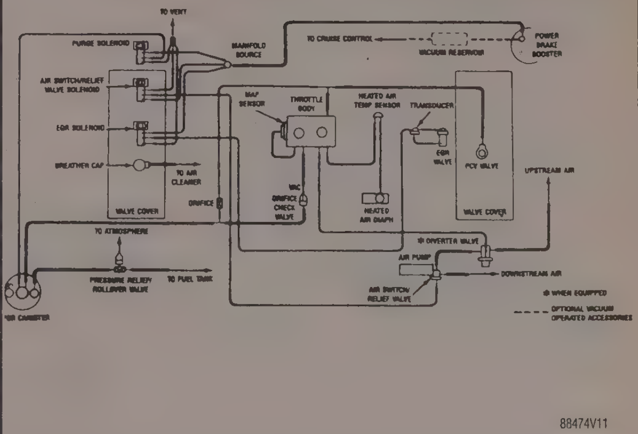
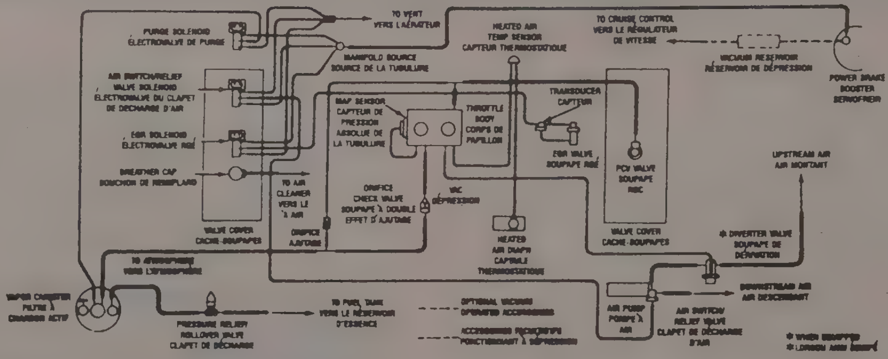
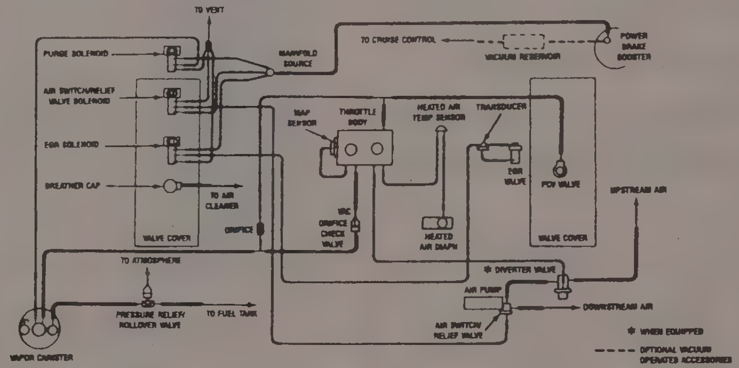

TO VENT
PURGE SOLENOID
MANIFOLD SOURCE
TO CRUISE CONTROL
VACUUM RESERVOIR
POWER BRAKE BOOSTER
AIR SWITCH/RELIEF VALVE SOLENOID
MAP SENSOR
THROTTLE BODY
HEATED AIR TEMP SENSOR
TRANSDUCER
EGR SOLENOID
EGR VALVE
PCV VALVE
BREATHER CAP
TO AIR CLEANER
UPSTREAM AIR
VAC
ORIFICE
ORIFICE CHECK VALVE
HEATED AIR DIAPH
VALVE COVER
VALVE COVER
TO ATMOSPHERE
* DIVERTER VALVE
AIR PUMP
DOWNSTREAM AIR
PRESSURE RELIEF/ ROLLOVER VALVE
TO FUEL TANK
AIR SWITCH/ RELIEF VALVE
VAPOR CANISTER
* WHEN EQUIPPED
OPTIONAL VACUUM OPERATED ACCESSORIES
88474V11

Fig. 65 Vacuum hose routing—1991–92 California 3.9L engine


PURGE SOLENOID
ÉLECTROVALVE DE PURGE
TO VENT
VERS L'AÉRATEUR
MANIFOLD SOURCE
SOURCE DE LA TUBULURE
HEATED AIR
TEMP SENSOR
CAPTEUR THERMOSTATIQUE
TO CRUISE CONTROL
VERS LE RÉGULATEUR
DE VITESSE
VACUUM RESERVOIR
RÉSERVOIR DE DÉPRESSION
POWER BRAKE
BOOSTER
SERVOFREIN
AIR SWITCH/RELIEF
VALVE SOLENOID
ÉLECTROVALVE DU CLAPET
DE DÉCHARGE D'AIR
MAP SENSOR
CAPTEUR DE
PRESSION
ABSOLUE DE
LA TUBULURE
THROTTLE
BODY
CORPS DE
PAPILLON
TRANSDUCER
CAPTEUR
EGR SOLENOID
ÉLECTROVALVE RGE
EGR VALVE
SOUPAPE RGE
PCV VALVE
SOUPAPE
RGC
UPSTREAM AIR
AIR MONTANT
BREATHER CAP
BOUCHON DE REMPLISSAGE
TO AIR
CLEANER
VERS LE
À AIR
ORIFICE
CHECK VALVE
SOUPAPE À DOUBLE
EFFET D'AJUTAGE
VAC
DÉPRESSION
VALVE COVER
CACHE-SOUPAPES
ORIFICE
AJUTAGE
HEATED
AIR DIAPH
CAPSULE
THERMOSTATIQUE
VALVE COVER
CACHE-SOUPAPES
* DIVERTER VALVE
SOUPAPE DE
DÉRIVATION
TO ATMOSPHERE
VERS L'ATMOSPHÈRE
VAPOR CANISTER
FILTRE À
CHARBON ACTIF
TO FUEL TANK
VERS LE RÉSERVOIR
D'ESSENCE
OPTIONAL VACUUM
OPERATED ACCESSORIES
DOWNSTREAM AIR
AIR DESCENDANT
PRESSURE RELIEF
ROLLOVER VALVE
CLAPET DE DÉCHARGE
ACCESSOIRES FACULTATIFS
FONCTIONNANT À DÉPRESSION
AIR PUMP
POMPE À
AIR
AIR SWITCH/
RELIEF VALVE
CLAPET DE DÉCHARGE
D'AIR
* WHEN EQUIPPED
* LORSQU'IL Y A LIEU

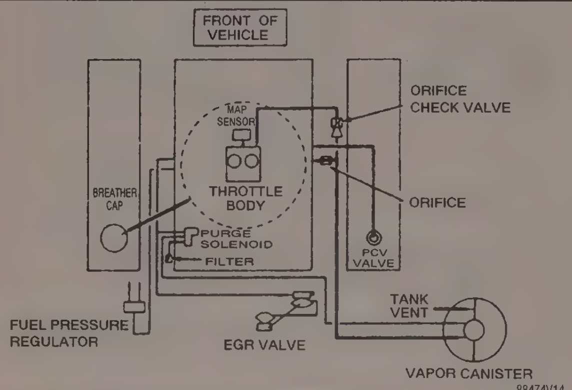
88474V12

Fig. 66 Vacuum hose routing—1991–92 Canadian 3.9L engine


TO VENT
PURGE SOLENOID
MANIFOLD
SOURCE
TO CRUISE CONTROL
VACUUM RESERVOIR
POWER
BRAKE
BOOSTER
AIR SWITCH/RELIEF
VALVE SOLENOID
MAP
SENSOR
THROTTLE
BODY
HEATED AIR
TEMP SENSOR
TRANSDUCER
EGR SOLENOID
EGR
VALVE
PCV VALVE
BREATHER CAP
TO AIR
CLEANER
UPSTREAM AIR
ORIFICE
VAC
ORIFICE
CHECK
VALVE
HEATED
AIR DIAPH
VALVE COVER
VALVE COVER
TO ATMOSPHERE
* DIVERTER VALVE
AIR PUMP
PRESSURE RELIEF
ROLLOVER VALVE
TO FUEL TANK
DOWNSTREAM AIR
AIR SWITCH/
RELIEF VALVE
* WHEN EQUIPPED
VAPOR CANISTER
OPTIONAL VACUUM
OPERATED ACCESSORIES

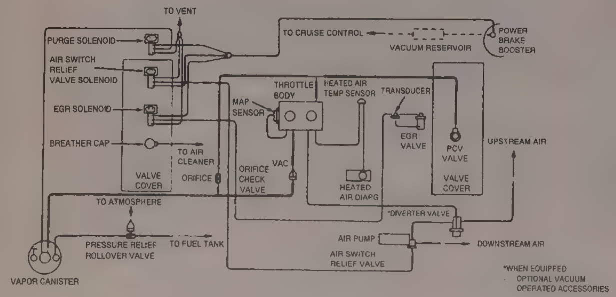
88474V13

Fig. 67 Vacuum hose routing—1991 heavy duty 5.9L engine


FRONT OF
VEHICLE
MAP
SENSOR
ORIFICE
CHECK VALVE
BREATHER
CAP
THROTTLE
BODY
ORIFICE
PURGE
SOLENOID
FILTER
PCV
VALVE
TANK
VENT
FUEL PRESSURE
REGULATOR
EGR VALVE
VAPOR CANISTER

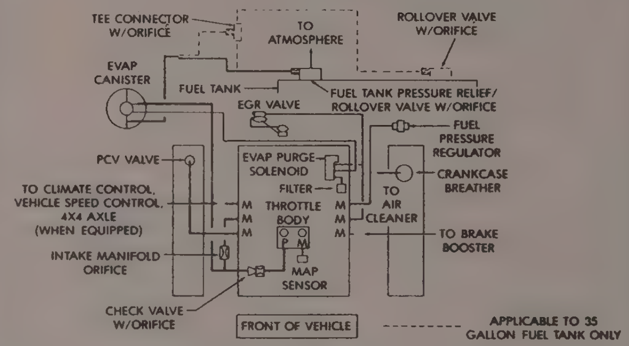
88474V14

Fig. 68 Vacuum hose routing—1992 Federal 3.9L engine


TO VENT
PURGE SOLENOID
TO CRUISE CONTROL
POWER
BRAKE
BOOSTER
VACUUM RESERVOIR
AIR SWITCH
RELIEF
VALVE SOLENOID
THROTTLE
BODY
HEATED AIR
TEMP SENSOR
TRANSDUCER
MAP
SENSOR
EGR SOLENOID
EGR
VALVE
PCV
VALVE
UPSTREAM AIR
BREATHER CAP
TO AIR
CLEANER
VAC
ORIFICE
ORIFICE
CHECK
VALVE
VALVE
COVER
HEATED
AIR DIAPG
VALVE
COVER
TO ATMOSPHERE
*DIVERTER VALVE
AIR PUMP
DOWNSTREAM AIR
PRESSURE RELIEF
ROLLOVER VALVE
TO FUEL TANK
AIR SWITCH
RELIEF VALVE
*WHEN EQUIPPED
OPTIONAL VACUUM
OPERATED ACCESSORIES
VAPOR CANISTER

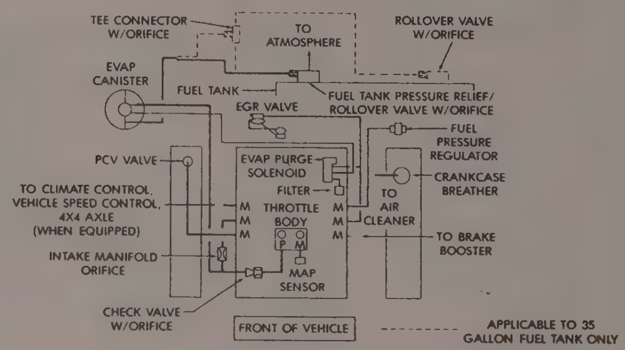
88474V15

Fig. 69 Vacuum hose routing—1992 California 5.9L engine


TEE CONNECTOR
W/ORIFICE
TO
ATMOSPHERE
ROLLOVER VALVE
W/ORIFICE
EVAP
CANISTER
FUEL TANK
FUEL TANK PRESSURE RELIEF/
ROLLOVER VALVE W/ORIFICE
EGR VALVE
FUEL
PRESSURE
REGULATOR
PCV VALVE
EVAP PURGE
SOLENOID
CRANKCASE
BREATHER
FILTER
TO
AIR
CLEANER
TO CLIMATE CONTROL,
VEHICLE SPEED CONTROL,
4X4 AXLE
(WHEN EQUIPPED)
THROTTLE
BODY
M
M
M
M
M
M
P
M
TO BRAKE
BOOSTER
INTAKE MANIFOLD
ORIFICE
MAP
SENSOR
CHECK VALVE
W/ORIFICE
FRONT OF VEHICLE
APPLICABLE TO 35
GALLON FUEL TANK ONLY

88474V17

Fig. 70 Vacuum hose routing—1993 Federal 5.2L engine


TEE CONNECTOR
W/ORIFICE
TO
ATMOSPHERE
ROLLOVER VALVE
W/ORIFICE
EVAP
CANISTER
FUEL TANK
FUEL TANK PRESSURE RELIEF/
ROLLOVER VALVE W/ORIFICE
EGR VALVE
FUEL
PRESSURE
REGULATOR
PCV VALVE
EVAP PURGE
SOLENOID
CRANKCASE
BREATHER
FILTER
TO
AIR
CLEANER
TO CLIMATE CONTROL,
VEHICLE SPEED CONTROL,
4X4 AXLE
(WHEN EQUIPPED)
THROTTLE
BODY
M
M
M
M
M
M
P
M
TO BRAKE
BOOSTER
INTAKE MANIFOLD
ORIFICE
MAP
SENSOR
CHECK VALVE
W/ORIFICE
FRONT OF VEHICLE
APPLICABLE TO 35
GALLON FUEL TANK ONLY

88474V18

Fig. 71 Vacuum hose routing—1993 California 5.2L engine

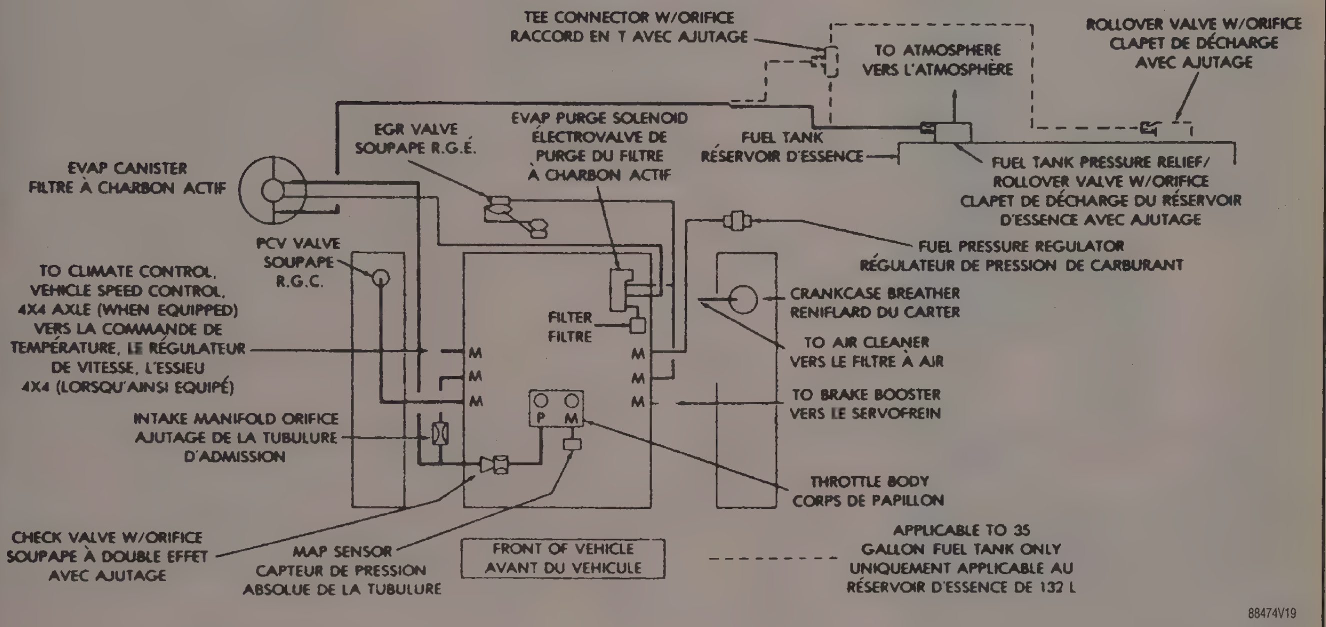

TEE CONNECTOR W/ORIFICE
RACCORD EN T AVEC AJUTAGE
TO ATMOSPHERE
VERS L'ATMOSPHÈRE
ROLLOVER VALVE W/ORIFICE
CLAPET DE DÉCHARGE
AVEC AJUTAGE
EGR VALVE
SOUPAPE R.G.É.
EVAP PURGE SOLENOID
ÉLECTROVALVE DE
PURGE DU FILTRE
À CHARBON ACTIF
FUEL TANK
RÉSERVOIR D'ESSENCE
EVAP CANISTER
FILTRE À CHARBON ACTIF
FUEL TANK PRESSURE RELIEF/
ROLLOVER VALVE W/ORIFICE
CLAPET DE DÉCHARGE DU RÉSERVOIR
D'ESSENCE AVEC AJUTAGE
PCV VALVE
SOUPAPE
R.G.C.
FUEL PRESSURE REGULATOR
RÉGULATEUR DE PRESSION DE CARBURANT
TO CLIMATE CONTROL,
VEHICLE SPEED CONTROL,
4X4 AXLE (WHEN EQUIPPED)
VERS LA COMMANDE DE
TEMPÉRATURE, LE RÉGULATEUR
DE VITESSE, L'ESSIEU
4X4 (LORSQU'AINSI EQUIPÉ)
CRANKCASE BREATHER
RENIFLARD DU CARTER
FILTER
FILTRE
TO AIR CLEANER
VERS LE FILTRE À AIR
M
M
M
M
M
M
P
M
TO BRAKE BOOSTER
VERS LE SERVOFREIN
INTAKE MANIFOLD ORIFICE
AJUTAGE DE LA TUBULURE
D'ADMISSION
THROTTLE BODY
CORPS DE PAPILLON
CHECK VALVE W/ORIFICE
SOUPAPE À DOUBLE EFFET
AVEC AJUTAGE
MAP SENSOR
CAPTEUR DE PRESSION
ABSOLUE DE LA TUBULURE
FRONT OF VEHICLE
AVANT DU VEHICULE
APPLICABLE TO 35
GALLON FUEL TANK ONLY
UNIQUEMENT APPLICABLE AU
RÉSERVOIR D'ESSENCE DE 132 L
88474V19

Fig. 72 Vacuum hose routing—1993 Canadian 5.2L engine

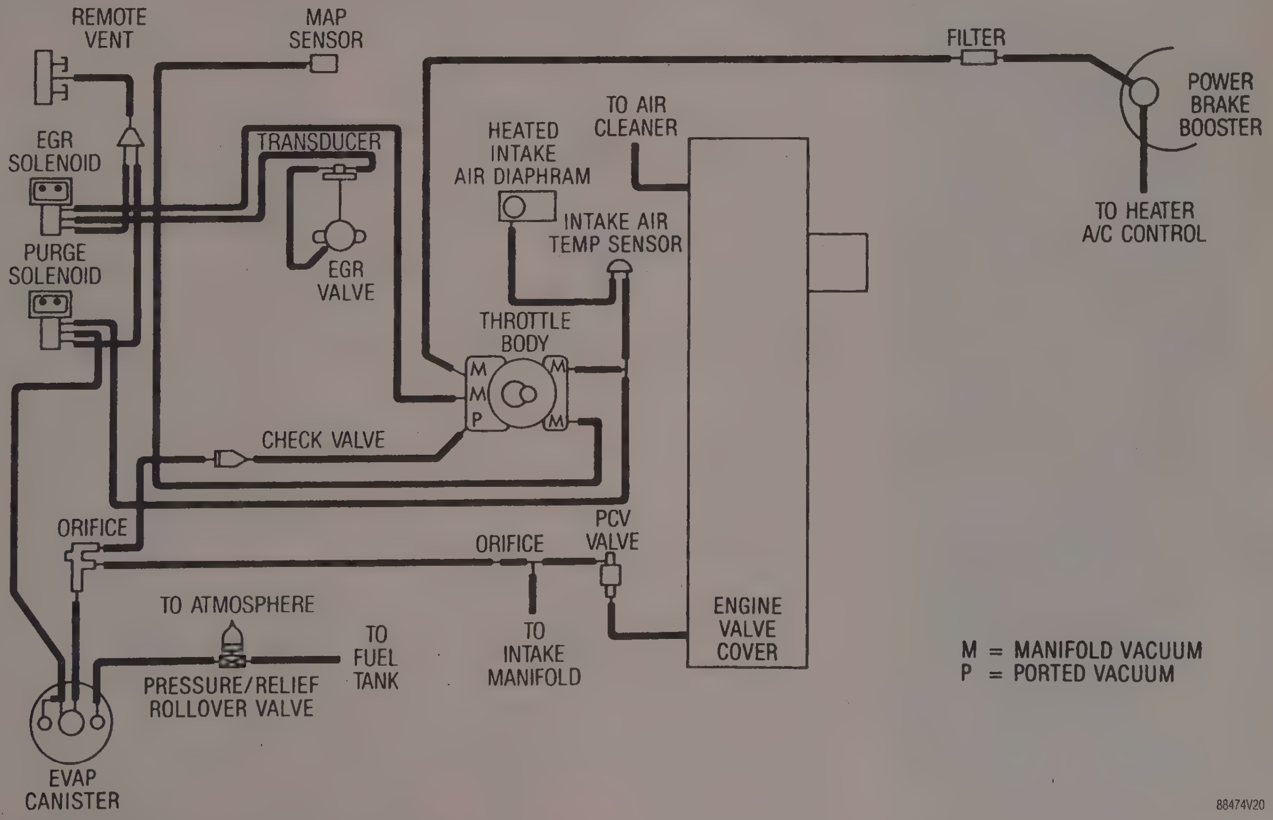
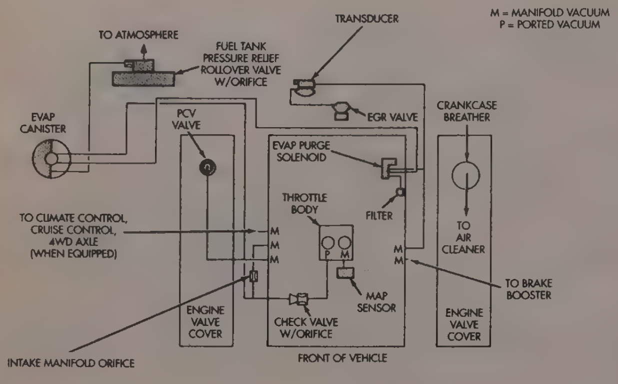
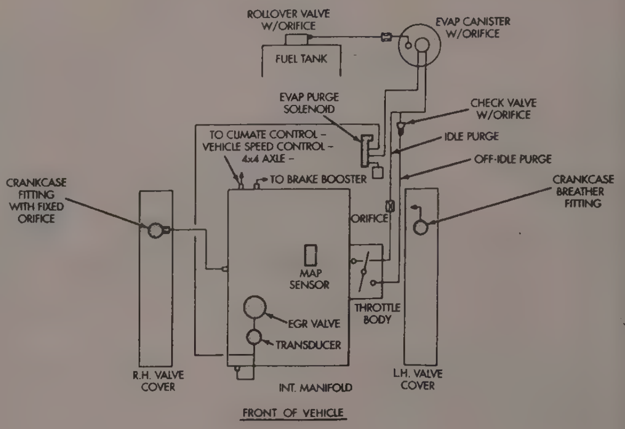

REMOTE
VENT
MAP
SENSOR
FILTER
POWER
BRAKE
BOOSTER
EGR
SOLENOID
TRANSDUCER
HEATED
INTAKE
AIR DIAPHRAM
TO AIR
CLEANER
TO HEATER
A/C CONTROL
INTAKE AIR
TEMP SENSOR
PURGE
SOLENOID
EGR
VALVE
THROTTLE
BODY
M
M
M
M
P
CHECK VALVE
ORIFICE
ORIFICE
PCV
VALVE
TO ATMOSPHERE
TO
FUEL
TANK
TO
INTAKE
MANIFOLD
ENGINE
VALVE
COVER
PRESSURE/RELIEF
ROLLOVER VALVE
M = MANIFOLD VACUUM
P = PORTED VACUUM
EVAP
CANISTER
88474V20

Fig. 73 Engine vacuum schematic—1994–96 2.5L engine


M = MANIFOLD VACUUM
P = PORTED VACUUM
TRANSDUCER
TO ATMOSPHERE
FUEL TANK PRESSURE RELIEF ROLLOVER VALVE W/ORIFICE
EVAP CANISTER
PCV VALVE
EGR VALVE
CRANKCASE BREATHER
EVAP PURGE SOLENOID
THROTTLE BODY
FILTER
TO CLIMATE CONTROL, CRUISE CONTROL, 4WD AXLE (WHEN EQUIPPED)
M
M
M
P
M
M
M
TO AIR CLEANER
TO BRAKE BOOSTER
MAP SENSOR
ENGINE VALVE COVER
CHECK VALVE W/ORIFICE
ENGINE VALVE COVER
INTAKE MANIFOLD ORIFICE
FRONT OF VEHICLE

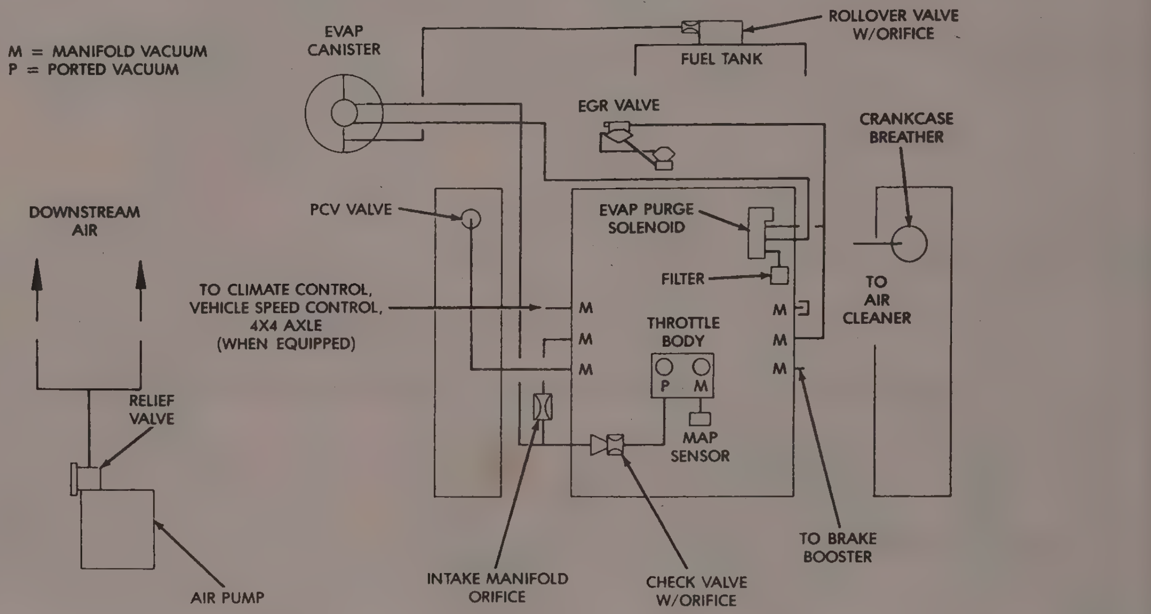
88474V21

Fig. 74 Engine vacuum schematic—1994–96 3.9L and 5.2L engines


ROLLOVER VALVE W/ORIFICE
EVAP CANISTER W/ORIFICE
FUEL TANK
EVAP PURGE SOLENOID
CHECK VALVE W/ORIFICE
TO CLIMATE CONTROL – VEHICLE SPEED CONTROL – 4x4 AXLE –
IDLE PURGE
OFF-IDLE PURGE
TO BRAKE BOOSTER
CRANKCASE FITTING WITH FIXED ORIFICE
CRANKCASE BREATHER FITTING
ORIFICE
MAP SENSOR
THROTTLE BODY
EGR VALVE
TRANSDUCER
R.H. VALVE COVER
INT. MANIFOLD
L.H. VALVE COVER
FRONT OF VEHICLE

88474V23

Fig. 75 Engine vacuum schematic—1994–96 8.0L engine


M = MANIFOLD VACUUM
P = PORTED VACUUM
EVAP CANISTER
ROLLOVER VALVE W/ORIFICE
FUEL TANK
EGR VALVE
CRANKCASE BREATHER
DOWNSTREAM AIR
PCV VALVE
EVAP PURGE SOLENOID
FILTER
TO AIR CLEANER
TO CLIMATE CONTROL, VEHICLE SPEED CONTROL, 4X4 AXLE (WHEN EQUIPPED)
M
M
M
THROTTLE BODY
M
M
M
P
M
RELIEF VALVE
MAP SENSOR
AIR PUMP
INTAKE MANIFOLD ORIFICE
CHECK VALVE W/ORIFICE
TO BRAKE BOOSTER

88474V22

Fig. 76 Engine vacuum schematic—1994–96 5.9L heavy duty engine

5

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FUEL LINES AND FITTINGS

The fuel lines/tubes/hoses used in the vehicles covered by this manual are specially constructed to accommodate the demands of the high pressure fuel injection system. Many fuel fittings are made of plastic and retained by tabs. Some are a conventional design of steel and thread into a port in the system component (such as early fuel return lines from the throttle body). The rubber fuel hoses used on the vehicles covered by this manual are retained by special hose clamps designed not to cut into the casing. Only this type of clamp may be used on the fuel system hoses. Replacement lines/tubes/hoses must be marked EFM/EFI to assure they are designed to meet specifications.

If you do any work on the fuel system requiring removal and installation of lines, avoid routing the tubes/hoses with other vehicle components that could abrade or scuff them. Also, be sure the plastic fuel lines/tubes are routed so as to prevent their being pinched and keep them away from heat sources. Never attempt to repair a plastic fuel line. Always replace damaged lines.

Quick-Connect Fittings

Quick-connect fittings are used at several fuel system connections. Most fittings have one or two retainer tabs that must be released before disconnecting the fittings from the fuel tube. Another type of quick-connect fitting uses a full-round plastic retainer and is usually black in color.

The fuel fittings with one tab are known as the "single-tab type." The fittings with dual tabs are the "two-tab type." Most earlier models (before 1994) used the single-tab type. The single tab-type is equipped with a single pull tab. The two-tab type has tabs located on both sides of the fitting. The fitting that uses a full-round retainer ring is known as the plastic retainer ring type fitting.

REMOVAL & INSTALLATION

Single-Tab Type

➧ See Figures 1 and 2

1. Relieve the fuel system pressure, as described later in this section.
2. Disconnect the negative battery cable.
3. Clean the fitting of any foreign material before disassembly.
4. Press the release tab on the side of the fitting to release the pull tab.

✲✲ WARNING

The release tab must be pressed prior to releasing the pull tab or the pull tab will be damaged.

5. While pressing the release tab on the side of the fitting, use a small prytool to pry up the pull tab.
6. Raise the pull tab until it separates from the quick-disconnect fitting. Discard the old pull tab.
7. Disconnect the quick-disconnect fitting from the fuel system component being serviced.
8. Inspect the fitting body and fuel system component for damage. Replace as necessary.

To install:

9. Before connecting the fitting, check the condition of the fitting and component being serviced. Clean with a lint-free cloth, then lubricate them with clean engine oil.
10. Insert the quick-connect fitting into the fuel tube or fuel system component until the built-on stop on the fuel tube or component rests against the back of the fitting.
11. Obtain a new pull tab. Push the new tab down until it locks in place in the quick-connect fitting.
12. Pull firmly (about 15–30 lbs. or 6.75–13.5 kg. of force) on the fuel tube to verify the fitting is locked.
13. Connect the negative battery cable.
14. Start the engine and check for leaks. Shut off the engine immediately if any are detected and repair the leaks.

Two-Tab Type

➧ See Figure 3

1. Perform the fuel system pressure release.
2. Disconnect the negative battery cable.
3. Clean the fitting of any foreign material before disassembly.
4. Squeeze the plastic retainer tabs against the sides of the fitting with your fingers. Pull the fitting from the fuel system component. The plastic retainer will stay on the component. The O-rings and spacer will remain in the fitting connector body.

✲✲ WARNING

When the fitting is disconnected, the plastic retainer will remain on the component being serviced. If this retainer must be removed, very carefully release the retainer from the component with two small prytools. After removal, inspect the retainer for cracks or any damage.

5. Inspect the fitting body and fuel system component for damage. Replace as necessary.

To install:

6. Before connecting the fitting, check the condition of the fitting and component being serviced. Clean with a lint-free cloth, then lubricate them with clean engine oil.
7. Insert the quick-connect fitting to the fuel system component being serviced and into the plastic retainer. When a connection is made, a click will be heard.
8. Pull firmly (about 15–30 lbs. or 6.75–13.5 kg. of force) on the fuel tube to verify the fitting is locked.
9. Connect the negative battery cable.
10. Start the engine and check for leaks. Shut off the engine immediately if any are detected and repair the leak.

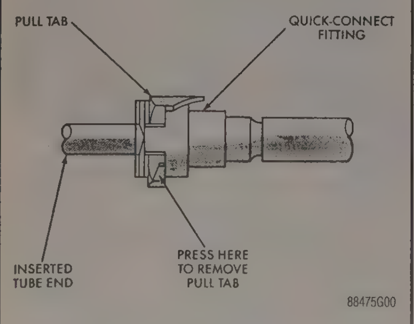


Fig. 1 A common single-tab type quick-connect fitting

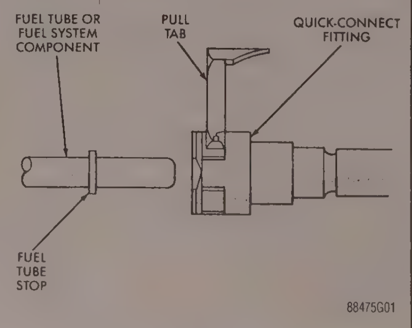


Fig. 2 Remove the pull tab from the single-tab type quick-connect fitting

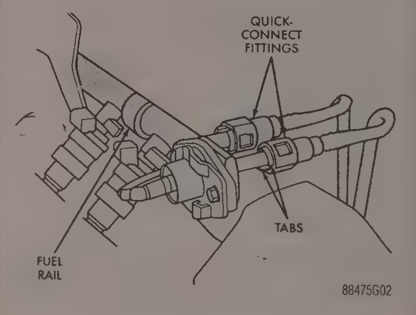


Fig. 3 A common two-tab type quick-connect fitting

Plastic Retainer Ring Type

➧ See Figure 4

1. Disconnect the negative battery cable.
2. Perform the fuel system pressure release.
3. Clean the fitting of any foreign material before disassembly.
4. To release the fitting, firmly push the fitting towards the component it's attached to while firmly pushing the plastic retainer ring into the fitting. Pull the fitting from the component. After disconnection, the plastic retainer ring will remain with the quick-connect fitting connector body.

➡The plastic retainer ring must be pressed squarely into the fitting body. If this retainer is cocked during removal, it may be difficult to remove the fitting. Use an open end wrench on the shoulder of the plastic retainer ring to air the disconnection.

5. Inspect the fitting body and fuel system component for damage. Replace as necessary.

To install:

6. Before connecting the fitting, check the condition of the fitting and component being serviced. Clean with a lint-free cloth, then lubricate them with clean engine oil.
7. Insert the quick-connect fitting to the fuel system component being serviced. When a connection is made, a click will be heard.
8. Pull firmly (about 15–30 lbs. or 6.75–13.5 kg. of force) on the fuel tube to verify the fitting is locked.
9. Connect the negative battery cable.
10. Start the engine and check for leaks. Shut off the engine immediately if any are detected and repair the leak.

Conventional Type Fittings

These are the threaded hex nut design that secure a tight fit between the flanged end of the fuel line and the system component.

REMOVAL & INSTALLATION

➧ See Figure 5

1. Remove the air cleaner assembly.
2. Perform the fuel system pressure release.
3. Disconnect the negative battery cable.
4. Loosen the fuel intake and return hose clamps. Wrap a shop towel around each hose, twist and pull off each hose.
5. Remove each fitting and note the inlet diameter. Remove the copper washers.
6. Installation is the reverse of removal. Secure the fuel fittings in the proper ports and tighten to 175 inch lbs. (20 Nm).
7. Test for leaks using Mopar® ATM tester C–4805 or equivalent. With the ignition in the **RUN** position depress the ATM button. This will activate the pump and pressurize the system.

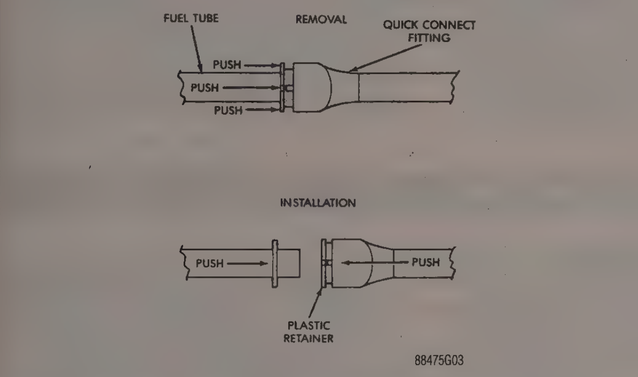


Fig. 4 The plastic retainer ring type quick-connect fitting

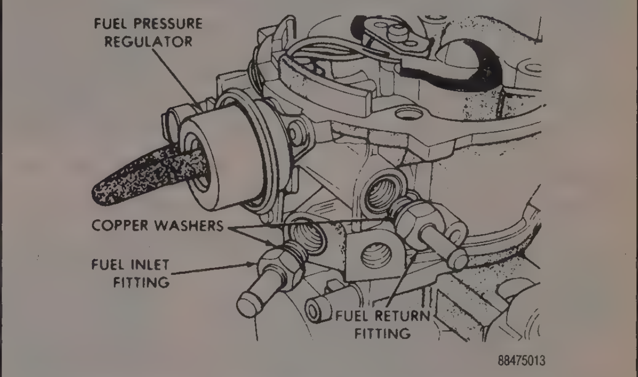


Fig. 5 Design details of conventional fuel line fittings

THROTTLE BODY FUEL INJECTION (TBI) SYSTEM

General Information

The TBI system is used on all 1989–95 2.5L engines, 1989–91 3.9L and 5.2L engines and 1989–92 5.9L engines. There are two systems: single point and dual point. As you might expect, single point uses only one fuel injector and dual point uses two injectors. The 2.5L uses single point, while the V6 and V8 engines use dual point injection. Although there are some component differences between models, both single point and dual point systems share basic operation and service procedures.

Both systems are controlled by a pre-programmed digital computer known as a Single Module Engine Controller (SMEC) on 1989 models, Single Board Engine Controller (SBEC) on 1990–91 models, Engine Controller on 1992 models, and Powertrain Control Module (PCM) on 1993–95 models. The computer controls ignition timing, air/fuel ratio, emission control devices, charging system and idle speed. The computer constantly varies timing, fuel delivery and idle speed to meet changing engine operating conditions.

Service Precautions

When working around any part of the fuel system, take precautionary steps to prevent possible fire and/or explosion:

- Disconnect the negative battery terminal, except when testing with battery voltage is required.
- Whenever possible, use a flashlight instead of a drop light to inspect fuel system components or connections.
- Keep all open flames and smoking material out of the area and make sure there is adequate ventilation to remove fuel vapors.
- Use a clean shop cloth to catch fuel when opening a fuel system. Dispose of gasoline-soaked rags properly.
- Relieve the fuel system pressure before any service procedures are attempted that require disconnecting a fuel line.
- Use eye protection.
- Always keep a dry chemical (class B) fire extinguisher near the area.

Relieving Fuel System Pressure

EXCEPT 1992–95 2.5L ENGINES

1. Loosen the gas cap to release tank pressure.
2. Remove the injector wiring harness connector from the engine harness.
3. Connect a jumper wire between ground terminal No. 1 of the injector harness and the engine ground.
4. Connect a jumper wire to the second terminal and touch the battery positive post for no longer than five seconds. This releases system pressure.
5. Remove the jumper wire and continue fuel system service.

1992–95 2.5L ENGINES

1. Disconnect the negative battery cable.
2. Remove the fuel tank filler cap to release any fuel tank pressure.
3. Unscrew the plastic cap from the pressure test port on the fuel rail.
4. Obtain a fuel pressure gauge/hose from a fuel pressure gauge tool set No. 5069, or equivalent. Remove the gauge, then place the gauge end of the hose into a suitable gasoline container.
5. Place a shop towel under the test port.
6. Screw the other end of the hose onto the fuel pressure port to relieve the pressure.
7. When the pressure has been relieved, remove the hose and cap the port.

Electric Fuel Pump

✲✲ CAUTION

The fuel injection system is under a constant pressure. Before servicing any part of the fuel injection system, the system pressure must be released. Use a clean shop towel to catch any fuel spray and take precautions to avoid the risk of fire.

The TBI system uses an electric fuel pump mounted in the fuel tank. The fuel pump used in this system is a positive displacement, roller vane immersible pump with a permanent magnet electric motor.

The fuel is drawn in through an in-tank filter unit (some models use a filter sock) and pushed through the electric motor to the outlet. The pump contains two check valves. One valve is used to relieve internal fuel pump pressure and regulate maximum pump output. The other check valve, located near the pump outlet, restricts fuel movement in either direction when the pump is not operational. Voltage to operate the pump is supplied through the Automatic Shutdown (ASD) relay.

REMOVAL & INSTALLATION

1. Relieve the fuel pressure procedure as described previously in this section.
2. Disconnect the negative battery cable.
3. Remove the fuel tank from the truck.
4. Remove the locking ring, then lift out the fuel pump module. Tag any lines for replacement.
5. Remove the sending unit attaching screws from the mounting bracket located on the drain tube.
6. Disconnect the wires from the sending unit, then remove the sending unit.
7. Remove the drain tube from the mounting lug at the bottom of the reservoir.
8. Remove the lower most coil of the drain tube from the mounting lugs on top of the reservoir. Be careful to avoid unsnapping the return line check valve cover from the bottom of the reservoir.
9. Release the pump mounting bracket from the reservoir. Press the bracket with both thumbs toward the center of the reservoir.
10. Remove the pump mounting bracket and rubber collar from the hose. Cut the hose clamp on the supply line and discard the clamp. Remove the pump/filter assembly. Pry the filter from the pump.
11. Installation is the reverse of removal.

TESTING

➡The fuel system test port is located on the fuel rail in the engine bay.

✲✲ CAUTION

Fuel system pressure must be relieved as previously described each time a fuel hose is to be disconnected. Take precautions to avoid the risk of fire.

1. Remove the fuel intake hose from the throttle body and connect fuel system pressure testers C–3292, and C–4749, or equivalent, between the fuel filter hose and the throttle body.
2. Start the engine and read the gauge. Pressure should be 14.5 psi (100 kPa):

➡Mopar® ATM tester C–4805 or equivalent can be used. With the ignition in RUN, depress the ATM button. This activates the fuel pump and pressurizes the system.

3. If the fuel pressure is below specifications:
   a. Install the tester between the fuel filter hose and the fuel line.
   b. Start the engine. If the pressure is now correct, replace the fuel filter. If no change is observed, gently squeeze the return hose. If the pressure increases, replace the pressure regulator. If no change is observed, the problem is either a plugged pump filter sock or a defective fuel pump.
4. If the pressure is above specifications:
   a. Remove the fuel return hose from the throttle body. Connect a substitute hose and place the other end of the hose in a clean container.
   b. Start the engine. If the pressure is now correct, check for a restricted fuel return line. If no change is observed, replace the fuel regulator.

Throttle Body

REMOVAL & INSTALLATION

▸ See Figures 6 thru 20

1. Remove the air cleaner.
2. Perform the fuel system pressure release.
3. Disconnect the negative battery cable.
4. Disconnect the vacuum hoses and electrical connectors. Tag as necessary any hoses/connectors to ease installation.
5. Disconnect the throttle cable and, if so equipped, speed control and kickdown cables/rod.
6. Remove the return spring, if applicable.
7. Disconnect the fuel intake and return hoses.
8. Remove the throttle body mounting bolts and lift the throttle body from the engine.
9. Installation is the reverse of removal. Secure the throttle body mounting screws to 15 ft. lbs. (20 Nm).

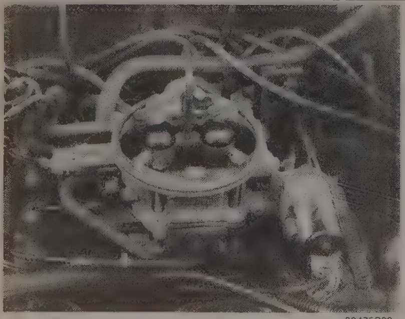
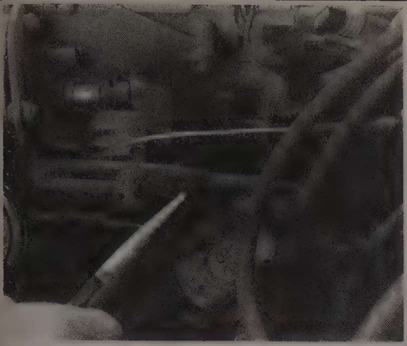


Fig. 6 A common dual point throttle body prior to removal—1990 3.9L engine shown

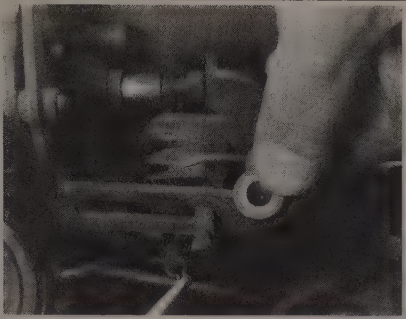
Fig. 7 You may wish to clamp the fuel lines to prevent any dripping

Fig. 8 Disconnect the barrel end of the throttle cable and position it out of the way



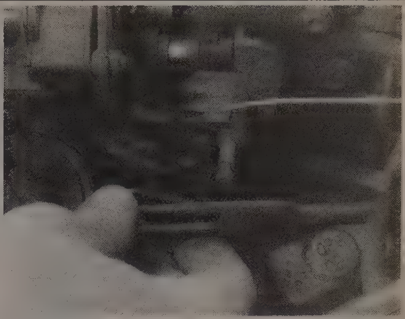
88475P00

Fig. 9 Remove the return spring from the throttle body—1990 3.9L engine shown



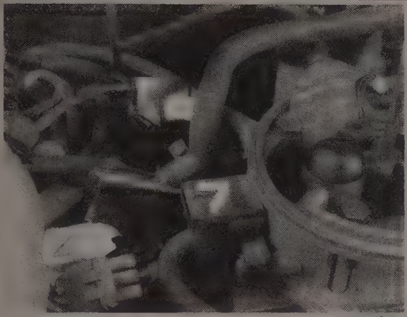
88475P01

Fig. 10 Be careful not to lose any small parts such as this washer and retaining clip



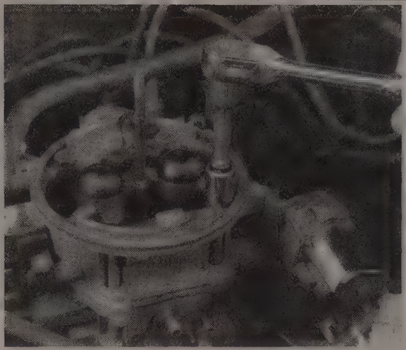
88475P02

Fig. 11 Remove the transmission kick-down rod link, if equipped—1990 3.9L engine shown



88475P05

Fig. 12 Disconnect the fuel hoses and set them aside. If mix-up is possible, tag them first



88475P06

Fig. 13 Unbolt the throttle body from the manifold

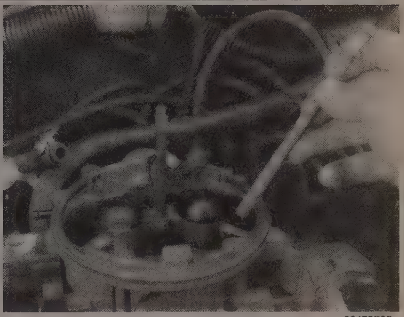


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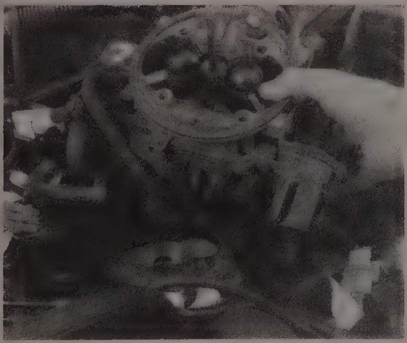
Fig. 14 Remove the bolts and set them in a safe place with the other related hardware



88475P08

Fig. 15 Remove the throttle body and set it in a clean, safe location

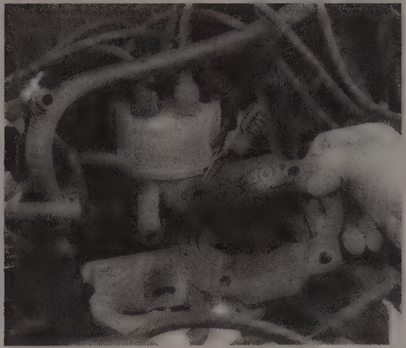


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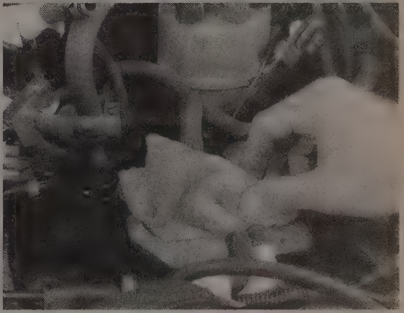
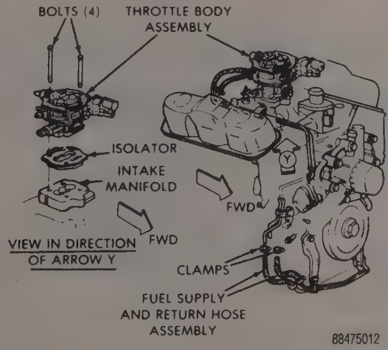
Fig. 16 Remove the old gasket and discard it



88475P10

Fig. 17 Stuff a clean rag into the manifold to prevent the entry of dirt or other foreign material



88475012

Fig. 18 Exploded view of throttle body mounting—V6 engine shown; others similar

Fuel Injector

REMOVAL & INSTALLATION

➧ See Figures 21, 22 and 23

1. Remove the air cleaner assembly.
2. Relieve the fuel system pressure as previously described in this section.
3. Disconnect the negative battery cable.
4. Remove the fuel pressure regulator.
5. Remove the Torx® screw holding down the injector cap.
6. With two small prytools, lift the cap off the injector using the slots provided.
7. Using a small prytool placed in the hole in the front of the electrical connector, gently pry the injector from pod.
8. Make sure the injector lower O-ring has been removed from the pod.

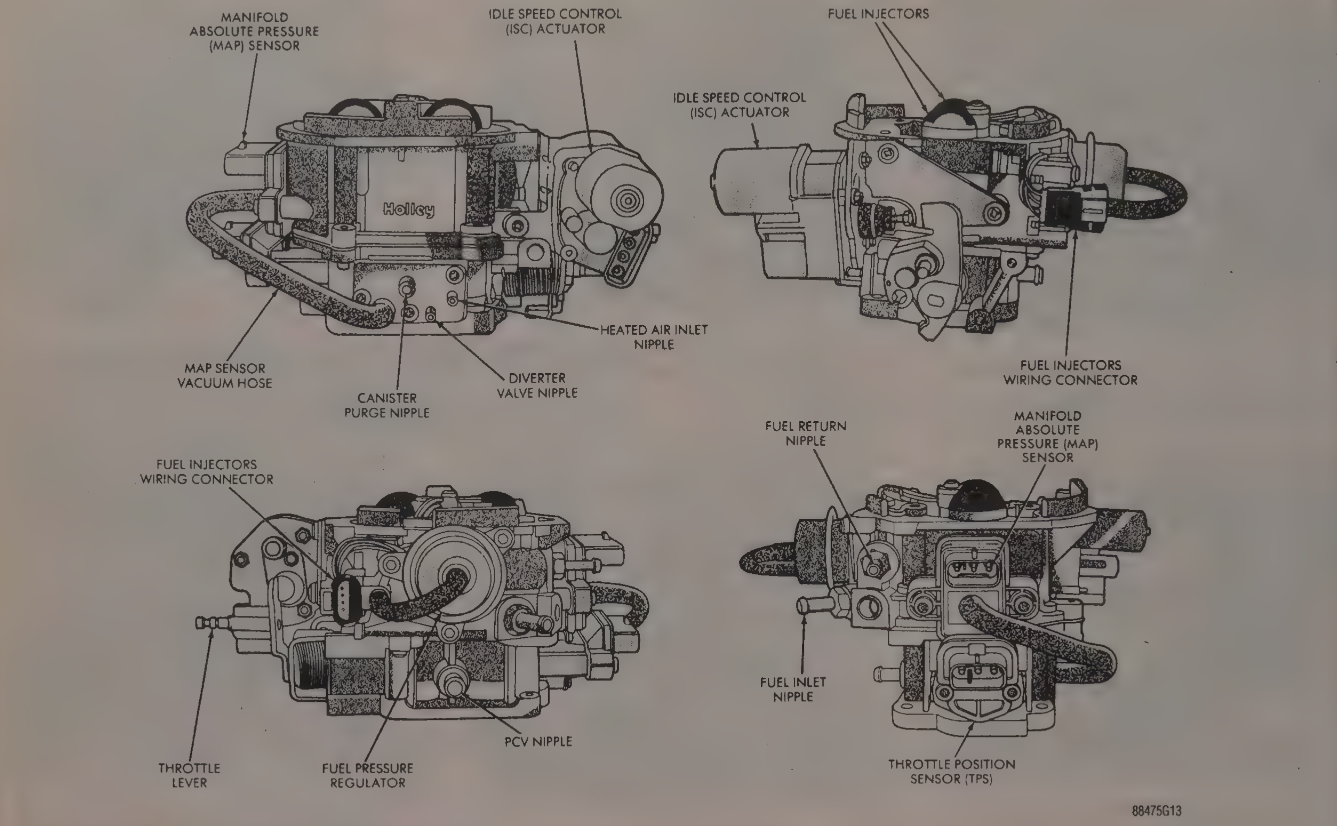

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
IDLE SPEED CONTROL (ISC) ACTUATOR
FUEL INJECTORS
IDLE SPEED CONTROL (ISC) ACTUATOR
Holley
HEATED AIR INLET NIPPLE
MAP SENSOR VACUUM HOSE
CANISTER PURGE NIPPLE
DIVERTER VALVE NIPPLE
FUEL INJECTORS WIRING CONNECTOR
FUEL RETURN NIPPLE
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
FUEL INJECTORS WIRING CONNECTOR
FUEL INLET NIPPLE
PCV NIPPLE
THROTTLE LEVER
FUEL PRESSURE REGULATOR
THROTTLE POSITION SENSOR (TPS)
88475G13

Fig. 19 Common V6 engine throttle body components

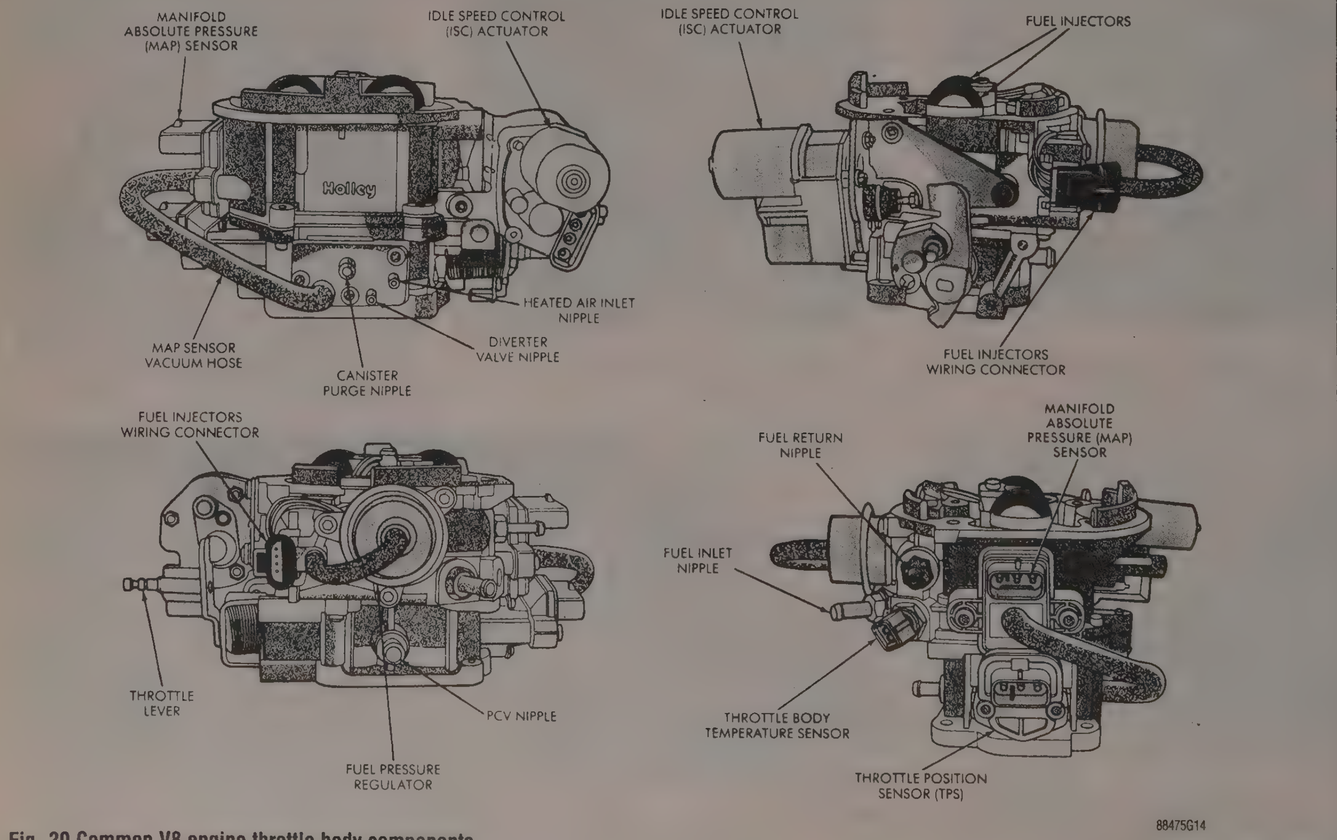

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
IDLE SPEED CONTROL (ISC) ACTUATOR
IDLE SPEED CONTROL (ISC) ACTUATOR
FUEL INJECTORS
Holley
HEATED AIR INLET NIPPLE
MAP SENSOR VACUUM HOSE
DIVERTER VALVE NIPPLE
CANISTER PURGE NIPPLE
FUEL INJECTORS WIRING CONNECTOR
FUEL INJECTORS WIRING CONNECTOR
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR
FUEL RETURN NIPPLE
FUEL INLET NIPPLE
THROTTLE LEVER
PCV NIPPLE
THROTTLE BODY TEMPERATURE SENSOR
FUEL PRESSURE REGULATOR
THROTTLE POSITION SENSOR (TPS)
88475G14

Fig. 20 Common V8 engine throttle body components

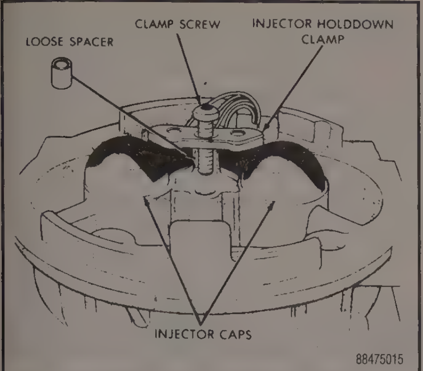


Fig. 21 Remove the injector cap holddown on the dual point TBI system

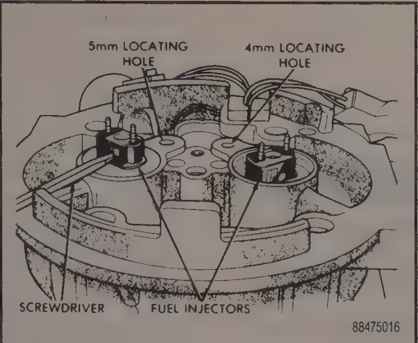


Fig. 22 A small screwdriver can be used to carefully pry the injector upward

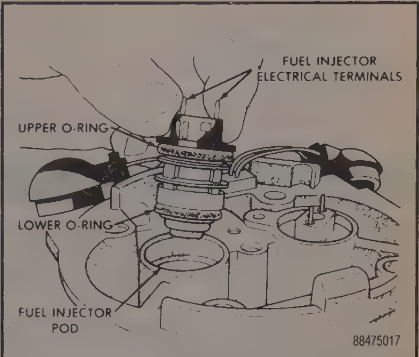


Fig. 23 When loose, remove the injector

To install:

9. Place a new lower O-ring on the injector and a new O-ring on the injector cap. The injector will have the upper O-ring already installed.
10. Put the injector cap on the injector. (Injector and cap are keyed). The cap should sit on the injector without interference. Apply a light coating of castor oil or petroleum jelly on the O-rings. Place the assembly in the pod.
11. Rotate the cap and injector to line up the attachment hole.
12. Push down on the cap until it contacts the injector pod.
13. Install the Torx® screw and tighten it to 35–45 inch lbs. (4–5 Nm).
14. Install the fuel pressure regulator.
15. Connect the negative battery cable. Test for leaks using Mopar® ATM tester C–4805, or equivalent. With the ignition in the **RUN** position depress the tester button. This will activate the pump and pressurize the system. Check for leaks.
16. Reinstall the air cleaner assembly.

Fuel Pressure Regulator

REMOVAL & INSTALLATION

➧ See Figure 24

1. Remove the air cleaner assembly.
2. Relieve the fuel system pressure as previously described.
3. Disconnect the negative battery cable.
4. Remove the three screws attaching the pressure regulator to the throttle body. Place a shop towel around the inlet chamber to contain any fuel remaining in the system.
5. Pull the pressure regulator from the throttle body.
6. Carefully remove the O-ring from the pressure regulator and remove the gasket.
7. Installation is the reverse of removal. Secure the pressure regulator on the throttle body screws to 40 inch lbs. (5 Nm).
8. Test for leaks using Mopar® ATM tester C–4805 or equivalent. With the ignition in the **RUN** position, depress the ATM button. This will activate the pump and pressurize the system. Check for leaks.

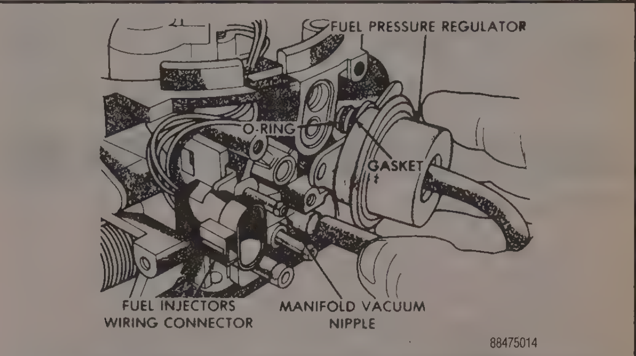


Fig. 24 When detached, remove the fuel pressure regulator and discard the gasket

Automatic Idle Speed (AIS) Motor Assembly

REMOVAL & INSTALLATION

1. Remove the air cleaner.
2. Disconnect the negative battery cable.
3. Disconnect the four pin connector on the AIS.
4. Remove the temperature sensor from the throttle body housing.
5. Remove the two Torx® head screws.
6. Remove the AIS from the throttle body housing, making sure that the O-ring is with the AIS.

To install:

7. Be sure that the pintle is in the retracted position. If the pintle extends more than 1 in. (25mm), it must be retracted by using ATM test code # 03.

➡The battery must be connected for this operation.

8. The remainder of installation is the reverse of removal.

MULTI-PORT FUEL INJECTION (MFI) SYSTEM

General Information

The sequential Multi-port Fuel Injection (MFI) System was introduced on all 3.9L and 5.2L engine-equipped models in 1992. As of the 1993 model year, all gasoline powered engines except the 2.5L were so equipped. The 2.5L engine was MFI-equipped for the 1996 model year.

The MFI system is controlled by a pre-programmed digital computer known as the Control Module on 1992 models, or the Powertrain Control Module on 1993–96 models. As with the TBI system it replaced, the MFI system computer controls ignition timing, air/fuel ratio, emission control devices, charging system and idle speed. The computer constantly varies timing, fuel delivery and idle speed to meet changing engine operating conditions.

As its name would imply, the chief difference of the MFI system is the utilization of individual fuel injectors at each cylinder. These injectors spray fuel in precisely metered amounts into the intake port directly above the intake valve. They are fired in the correct sequence by the engine controller which constantly reads conditions in order to maintain the ideal air/fuel ratio (stoichiometric) of 14.7:1. By adjusting the length of time the injector opens and sprays fuel into the chamber (pulse width), the proper air/fuel ratio is maintained which greatly helps increase power, driveability and emissions.

The primary variables that the engine controller uses to determine pulse width are manifold absolute pressure (air density) and engine rpm (speed). In addition to manifold absolute pressure (MAP) and engine speed (rpm), the engine controller also considers input from the following sensors to determine the pulse width:

- Exhaust gas content
- Coolant temperature

- Throttle position
- Battery voltage
- Air conditioning selection
- Transmission gear selection
- Speed control

Service Precautions

When working around any part of the fuel system, take precautionary steps to prevent possible fire and/or explosion:

- Disconnect the negative battery terminal, except when testing with battery voltage is required.
- Whenever possible, use a flashlight instead of a drop light to inspect fuel system components or connections.
- Keep all open flames and smoking material out of the area and make sure there is adequate ventilation to remove fuel vapors.
- Use a clean shop cloth to catch fuel when opening a fuel system. Dispose of gasoline-soaked rags properly.
- Relieve the fuel system pressure before any service procedures are attempted that require disconnecting a fuel line.
- Use eye protection.
- Always keep a dry chemical (class B) fire extinguisher near the area.

Relieving Fuel System Pressure

▶ See Figures 25 and 26

1. Disconnect the negative battery cable.
2. Remove the fuel tank filler cap to release any fuel tank pressure.
3. Unscrew the plastic cap from the pressure test port on the fuel rail. On the 8.0L engine, the test port is found at the front of the engine.
4. Obtain a fuel pressure gauge/hose from a fuel pressure gauge tool set No. 5069, or equivalent. Remove the gauge, then place the gauge end of the hose into a suitable gasoline container.
5. Place a shop towel under the test port.
6. Screw the other end of the hose onto the fuel pressure port to relieve the pressure.
7. When the pressure has been relieved, remove the hose and cap the port.

Electric Fuel Pump

✻✻ CAUTION

The fuel injection system is under a constant pressure. Before servicing any part of the fuel injection system, the system pressure must be released. Use a clean shop towel to catch any fuel spray and take precautions to avoid the risk of fire.

The MFI system uses an electric fuel pump mounted in the fuel tank. The fuel pump used in this system is a positive displacement, roller vane immersible pump with a permanent magnet electric motor.

For 1992–93 3.9L and 5.2L models, the fuel is drawn in through an in-tank filter unit and pushed through the electric motor to the outlet. The pump contains two check valves. One valve is used to relieve internal fuel pump pressure and regulate maximum pump output. The other check valve, located near the pump outlet, restricts fuel movement in either direction when the pump is not operational. Voltage to operate the pump is supplied through the Auto Shutdown (ASD) relay.

For 1993–96 5.9L and 1994–96 3.9L/5.2L/8.0L models, as well as 1996 2.5L models with the "returnless" fuel injection system, the fuel pump is referred to as the "fuel pump module". For the returnless system, the fuel is drawn in through an opening tube in the bottom of a filter/regulator. The regulator portion is calibrated to maintain a fuel pressure of approximately 35–45 psi (241–310 kPa). The internal fuel filter is built into the assembly. The filter/regulator contains a diaphragm, calibrated springs and a fuel return valve. An internal check valve maintains some fuel pressure when the engine is not running to enable a satisfactory start-up. The internal diaphragm routes fuel in excess of 45 psi (310 kPa) back to the fuel tank. With this system, proper fuel pressure is controlled at the source, so there is no need for a separate return line from the engine to the tank as found in conventional fuel systems.

REMOVAL & INSTALLATION

1992–93 3.9L/5.2L Models

1. Perform the fuel pressure release procedure described previously in this section.
2. Properly relieve the fuel system pressure and disconnect the negative battery cable.
3. Remove the fuel tank from the truck.
4. Remove the locking ring, then lift out the fuel pump module. Tag any lines for replacement.
5. Remove the sending unit attaching screws from the mounting bracket located on the drain tube.
6. Disconnect the wires from the sending unit, then remove the sending unit.
7. Remove the drain tube from the mounting lug at the bottom of the reservoir.
8. Remove the lower-most coil of the drain tube from the mounting lugs on top of the reservoir. Be careful to avoid unsnapping the return line check valve cover from the bottom of the reservoir.
9. Release the pump mounting bracket from the reservoir. Press the bracket with both thumbs toward the center of the reservoir.
10. Remove the pump mounting bracket and rubber collar from the hose. Cut the hose clamp on the supply line and discard the clamp. Remove the pump/filter assembly. Pry the filter from the pump.
11. Installation is the reverse of removal.

1993–96 5.9L, 1994–96 3.9L/5.2L/8.0L and 1996 2.5L Models

1. Perform the fuel pressure release procedure described previously in this section.
2. Properly relieve the fuel system pressure and disconnect the negative battery cable.
3. Remove the fuel tank from the truck.
4. Note the direction of the fuel filter/fuel pressure regulator, the pressure relief/rollover valve and the pump electrical connector. These should all be pointed to the driver's side. Tag any lines for replacement, if necessary.

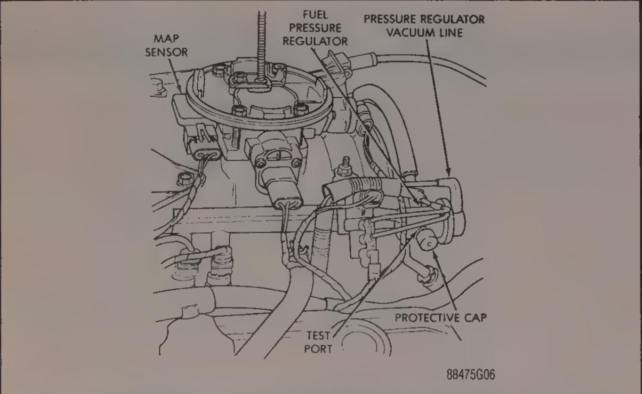


Fig. 25 Fuel pressure test port—1992–96 3.9L engine

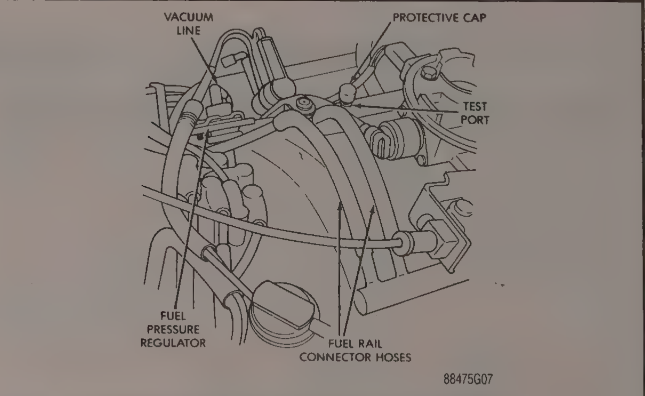


Fig. 26 Fuel pressure test port—1992–96 5.2L engine

5. Remove the locknut threaded into the fuel tank. The fuel pump module will spring up when the locknut is removed.
6. Remove the module from the fuel tank.
7. Installation is the reverse of removal.

TESTING

➡The fuel system test port is located on the fuel rail in the engine bay.

1992–93 3.9L/5.2L Models

➧ See Figures 25, 26 and 27

✱✱ CAUTION

Fuel system pressure must be released as previously described each time a fuel hose is to be disconnected. Take precautions to avoid the risk of fire.

1. Remove the fuel intake hose from the throttle body and connect fuel system pressure testers C–3292, and C–4749, or equivalent, between the fuel filter hose and the throttle body.
2. Start the engine and read the gauge. Pressure should be 14.5 psi (10 k Pa).

➡Mopar® ATM tester C–4805 or equivalent can be used. With the ignition in the RUN position, depress the ATM button. This activates the fuel pump and pressurizes the system.

3. If the fuel pressure is below specifications:
   a. Install the tester between the fuel filter hose and the fuel line.
   b. Start the engine. If the pressure is now correct, replace the fuel filter. If no change is observed, gently squeeze the return hose. If the pressure increases, replace the pressure regulator. If no change is observed, the problem is either a plugged pump filter sock or a defective fuel pump.
4. If the pressure is above specifications:
   a. Remove the fuel return hose from the throttle body. Connect a substitute hose and place the other end of the hose in a clean container.
   b. Start the engine. If the pressure is now correct, check for a restricted fuel return line. If no change is observed, replace the fuel regulator.

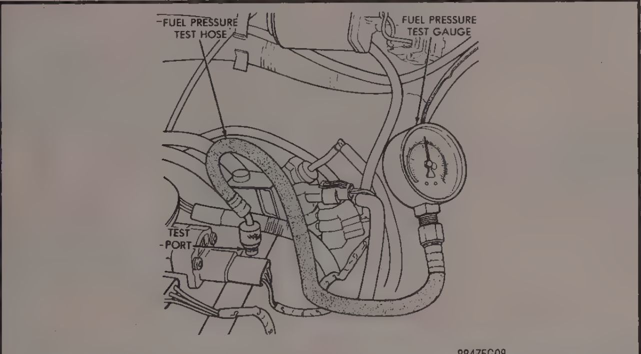


Fig. 27 A common fuel pressure test using a screw-in gauge rated to at least 60 psi (414 kPa)

1993–96 5.9L, 1994–96 3.9L/5.2L/8.0L and 1996 2.5L Models

➧ See Figures 25, 26 and 27

➡With the engine at idle, the system fuel pressure should be within 35–45 psi (241–310 kPa).

1. Uncap the pressure test port and screw in a fuel pressure gauge designed to read 0–60 psi (0–414 kPa), such as from set No. 5069. On the 8.0L engine, the test port is found at the front of the engine.
2. Read the gauge. If within specifications, it will show 35–45 psi (241–310 kPa).
3. If the pressure is 0 psi/kPa, you will need more extensive diagnosis using a DRBII or equivalent scan tool, and the appropriate Powertrain Diagnostics Procedures service manual. If the pressure is above 45 psi (310 kPa), the fuel pump is okay. Replace the fuel filter/fuel pressure regulator assembly.

Throttle Body

➡A factory adjusted setscrew is used to limit the position of the throttle plate. NEVER attempt to adjust the engine idle speed using this screw. All idle speed functions are controlled by the engine controller.

REMOVAL & INSTALLATION

➧ See Figures 28 and 29

1. Remove the air cleaner.
2. Perform the fuel system pressure release.
3. Disconnect the negative battery cable.
4. Disconnect the vacuum hoses and electrical connectors. Tag as necessary any hoses/connectors to ease installation.
5. Remove the throttle cable and, if so equipped, speed control and kickdown cables.
6. Remove the return spring, if applicable.
7. Remove the fuel intake and return hoses, if applicable.
8. Remove the throttle body mounting bolts and lift the throttle body from the engine.
9. Installation is the reverse of removal. When installing the throttle body, use a new gasket. Install the throttle body and tighten the mounting screws to 200 inch lbs. (23 Nm).

Fuel Injector

REMOVAL & INSTALLATION

➧ See Figure 30

1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. Perform the fuel system pressure release.

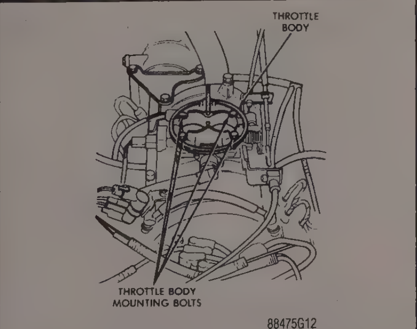


Fig. 28 Four bolts secure the throttle body to the intake manifold—3.9L engine shown; V8 engines similar

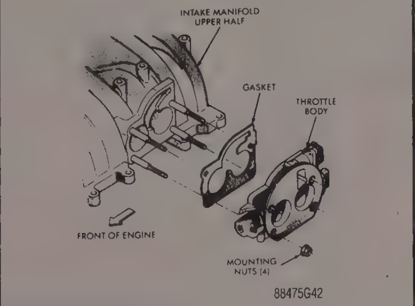


Fig. 29 On the 8.0L engine, a two-barrel side-mounted type throttle body is mounted to the upper half of the intake manifold

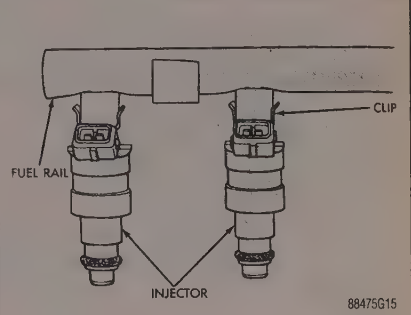


Fig. 30 Remove the clip, then the injector from the fuel rail

4. Remove the fuel rail assembly.
5. Remove the clip(s) retaining the injector(s) to the fuel rail.
6. Remove the injector(s) from the fuel rail.

To install:

7. Apply a small amount of engine oil to each injector O-ring.
8. Install the injector(s) and clip(s). Install the fuel rail assembly.
9. Install the air cleaner, connect the negative battery cable, then check for leaks.

TESTING

➧ See Figures 31 and 32

A complete test of the fuel injectors and related circuitry is only possible using a DRBII or equivalent scan tool, and the appropriate Powertrain Diagnostics Procedures manual. This test is for the injector only.

1. Disconnect the wire harness connector from the fuel injector.
2. Place an ohmmeter across the injector terminals. The resistance reading should be approximately 13.3–15.7 ohms at 68°F (20°C).
3. `Replace the injector if it fails to meet specification.

Fuel Rail

REMOVAL & INSTALLATION

2.5L Engine

1. Remove the fuel tank filler cap
2. Disconnect the negative battery cable.
3. Perform the fuel system pressure release procedure.
4. Remove the air cleaner housing.
5. Disconnect the throttle cable.
6. Remove the fuel injector harness connectors. These may be numerically tagged from the factory, but if they are not, tag them accordingly to facilitate installation.
7. Disconnect the fuel supply line from the fuel rail. Remove the fuel rail mounting bolts
8. Remove the fuel rail by gently rocking until the four injectors are out of the manifold.
9. Apply a small amount of engine oil to each fuel injector O-ring.
10. With the injectors installed to the rail, position the injector tips into their respective bores in the intake manifold.
11. Being careful not to tear the O-rings, seat the injectors into the bores.
12. Tighten the fuel rail mounting bolts to 20 ft. lbs. (27 Nm). The remainder of installation is the reverse of removal. Tighten each component to specifications. Start the engine and check for leaks.

V6 and V8 Engines

➧ See Figures 33, 34, 35 and 36

✲✲ WARNING

The fuel rail connecting hose is not meant to come off. Do not remove it or attempt to clamp it. The left and right fuel rails must be removed and installed as an assembly.

1. Disconnect the negative battery cable.
2. Remove the air cleaner tube and housing.
3. Release the fuel system pressure.
4. Remove the throttle body from the intake manifold.
5. If equipped with air conditioning, remove the A/C compressor-to-intake manifold support bracket.
6. Unplug the electrical connectors at all of the injectors. The factory harness should already be numerically tagged (INJ 1, INJ 2, etc.) to ease reconnection.
7. On the V6 engine, unplug the connector at the intake manifold air temperature sensor. Do not remove the sensor.
8. Remove the evaporative emissions (EVAP) purge solenoid/bracket assembly.

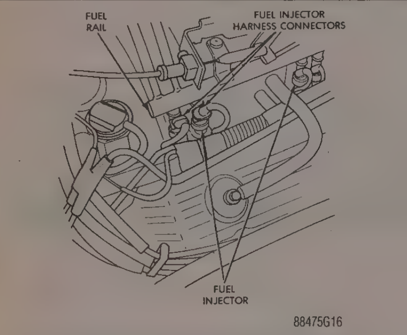

FUEL RAIL
FUEL INJECTOR HARNESS CONNECTORS
FUEL INJECTOR
88475G16

Fig. 31 Unplug the fuel injector connector, then place an ohmmeter across the terminals to measure resistance

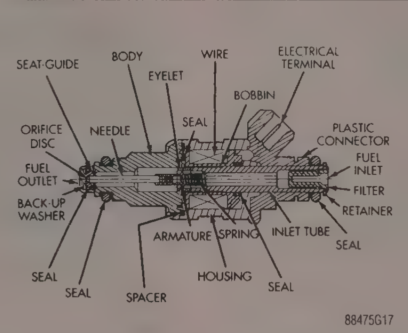

SEAT-GUIDE
BODY
WIRE
ELECTRICAL TERMINAL
EYELET
BOBBIN
SEAL
ORIFICE DISC
NEEDLE
PLASTIC CONNECTOR
FUEL INLET
FUEL OUTLET
FILTER
BACK-UP WASHER
RETAINER
ARMATURE
SPRING
INLET TUBE
SEAL
SEAL
HOUSING
SEAL
SEAL
SPACER
88475G17

Fig. 32 Cutaway view of a common MFI fuel injector

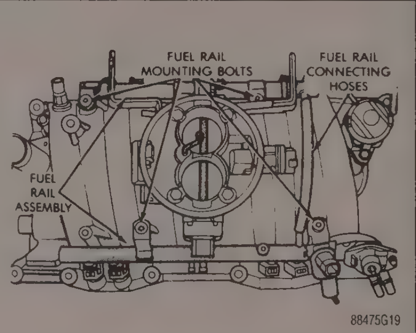

FUEL RAIL MOUNTING BOLTS
FUEL RAIL CONNECTING HOSES
FUEL RAIL ASSEMBLY
88475G19

Fig. 33 A common fuel rail—V6 and V8 engines

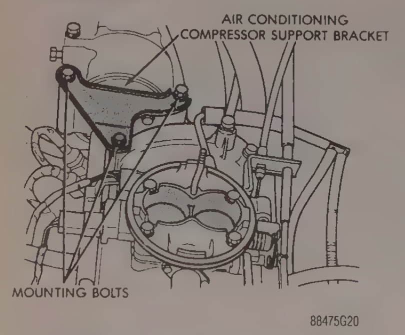

AIR CONDITIONING COMPRESSOR SUPPORT BRACKET
MOUNTING BOLTS
88475G20

Fig. 34 Remove the A/C compressor support bracket to access the fuel rail—V6 and V8 engines

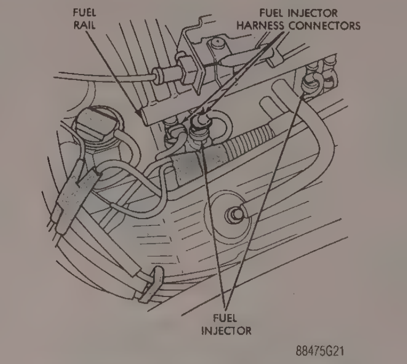

FUEL RAIL
FUEL INJECTOR HARNESS CONNECTORS
FUEL INJECTOR
88475G21

Fig. 35 A common design of injector connectors—V6 and V8 engines

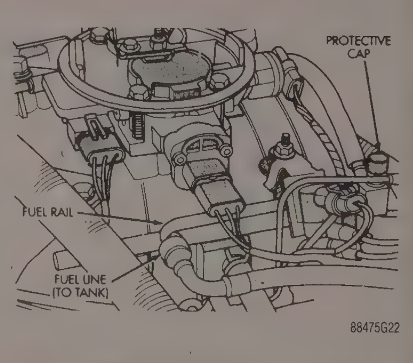

PROTECTIVE CAP
FUEL RAIL
FUEL LINE (TO TANK)
88475G22

Fig. 36 Remove the fuel line at the fuel rail—V6 and V8 engines

9. Disconnect the main fuel line at the side of the fuel rail.
10. Remove the remaining fuel rail mounting bolts.
11. Gently rock and pull the LEFT fuel rail until the injectors just start to clear the intake manifold. Then do the same for the right. Alternate each side progressively until all left and right injectors have cleared the intake manifold.
12. With the injectors attached, remove the fuel rail.

To install:

13. Apply a small amount of engine oil to each fuel injector O-ring.
14. With the injectors attached, position the fuel rail/fuel injector assembly to the injector openings on the intake manifold.
15. Guide each injector into the manifold. Be careful not to tear any O-rings.
16. Push the RIGHT fuel rail down until the injectors bottom on the injector shoulder. Then do the same for the left side injectors.
17. Install the fuel rail mounting bolts.
18. The remainder of installation is the reverse of removal. Tighten each component to specifications.
19. Start the engine and check for leaks. If any are detected, shut the engine off immediately and correct.

V10 Engine

➧ See Figure 37

1. Disconnect the negative battery cable.
2. Remove the air cleaner tube and housing.
3. Release the fuel system pressure.
4. Remove the throttle body from the intake manifold.
5. Remove the ignition coil pack and bracket assembly at the intake manifold and right cylinder head (valve) cover.
6. Remove the upper half of the intake manifold.

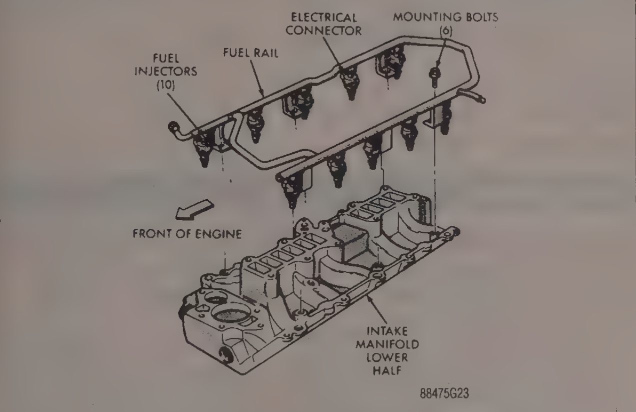


Fig. 37 Exploded view of the fuel rail mounting—V10 engine

7. Unplug the electrical connectors at all of the injectors. The factory harness should already be numerically tagged (INJ 1, INJ 2, etc.) to facilitate reconnection.
8. Disconnect the main fuel line at the rear of the engine.
9. Remove the six fuel rail mounting bolts from the lower half of the intake manifold.
10. Gently rock and pull the LEFT fuel rail until the injectors just start to clear the intake manifold. Then do the same for the right. Alternate each side progressively until all left and right injectors have cleared the intake manifold.
11. With the injectors attached, remove the fuel rail.

To install:

12. Apply a small amount of engine oil to each fuel injector O-ring.
13. With the injectors attached, position the fuel rail/fuel injector assembly to the injector openings on the intake manifold.
14. Guide each injector into the manifold. Be careful not to tear any O-rings.
15. Push the RIGHT fuel rail down until the injectors bottom on the injector shoulder. Then do the same for the left side injectors.

➡The fuel injector electrical connectors on all 10 injectors should be facing to the right (passenger) side of the vehicle.

16. Install the six fuel rail mounting bolts. Tighten them to 136 inch lbs. (15 Nm).
17. The remainder of installation is the reverse of removal. Tighten each component to specifications.
18. Start the engine and check for leaks. If any are detected, shut the engine off immediately and correct.

Automatic Idle Speed (AIS) Motor Assembly

REMOVAL & INSTALLATION

1. Remove the air cleaner.
2. Disconnect the negative battery cable.
3. Disconnect the four pin connector on the AIS.
4. Remove the temperature sensor from the throttle body housing.
5. Remove the two Torx® head screws.
6. Remove the AIS from the throttle body housing, making sure that the O-ring is with the AIS.

To install:

7. Be sure that the pintle is in the retracted position. If the pintle extends more than 1 in. (25mm), it must be retracted by using ATM test code # 03.

➡The battery must be connected for this operation.

8. Install new a O-ring on the AIS. Install the AIS into the housing making sure the O-ring is in place. Install the two Torx® head screws.
9. Connect the four pin connector to the AIS, install the temperature sending unit into the throttle body housing.
10. Connect the negative battery cable.

DIESEL FUEL SYSTEM

➧ See Figure 38

Injection Lines

The high pressure fuel lines deliver the diesel fuel under pressure of approximately 8000 psi (59,000 kPa) from the injection pump to the fuel injectors. The lines expand and contract with the high pressure fuel pulses generated during the injection process. All the high pressure fuel lines are of the same length and inside diameter. Correct line usage and installation is critical.

The high pressure fuel lines must be retained securely in their holders. The lines must not be allowed to contact each other or other components along side of them. If a line fails, it must be replaced with the correct replacement. Repair is not possible.

✻✻ CAUTION

If examining for leaks, use a sheet of cardboard to show any spraying fuel. Do not use your hand and wear safety goggles. The extremely high pressure can cause serious personal injury, especially to your skin and eyes.

Injectors

GENERAL INFORMATION

➧ See Figure 39

The fuel injectors are mounted on the left side of the cylinder head and are connected to the fuel pump by the high pressure fuel lines.

The injectors consist of the nozzle holder, O-ring, water seal, shims, spring, needle valve and nozzle. Fuel enters the injector through the top of the injector (fuel inlet) and is routed to the needle valve bore. The injector fires when fuel pressure rises to an amount sufficient to overcome the needle valve spring tension. For 1989–93 models, this pressure is 3,550 psi (24,445 kPa). For

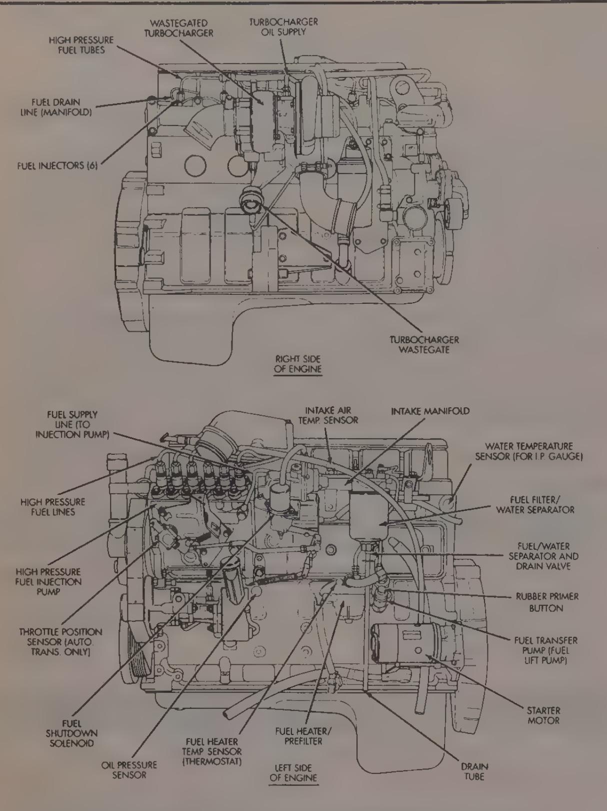

WASTEGATED TURBOCHARGER
TURBOCHARGER OIL SUPPLY
HIGH PRESSURE FUEL TUBES
FUEL DRAIN LINE (MANIFOLD)
FUEL INJECTORS (6)
TURBOCHARGER WASTEGATE
RIGHT SIDE OF ENGINE
FUEL SUPPLY LINE (TO INJECTION PUMP)
INTAKE AIR TEMP. SENSOR
INTAKE MANIFOLD
WATER TEMPERATURE SENSOR (FOR I.P. GAUGE)
HIGH PRESSURE FUEL LINES
FUEL FILTER/ WATER SEPARATOR
FUEL/WATER SEPARATOR AND DRAIN VALVE
HIGH PRESSURE FUEL INJECTION PUMP
RUBBER PRIMER BUTTON
THROTTLE POSITION SENSOR (AUTO. TRANS. ONLY)
FUEL TRANSFER PUMP (FUEL LIFT PUMP)
STARTER MOTOR
FUEL SHUTDOWN SOLENOID
FUEL HEATER/ PREFILTER
FUEL HEATER TEMP SENSOR (THERMOSTAT)
OIL PRESSURE SENSOR
LEFT SIDE OF ENGINE
DRAIN TUBE

Fig. 38 Common diesel fuel system components—1995 model shown; others are similar

1994–96 models, the pressure needed to overcome the needle valve spring tension is a little higher at 3,822 psi (26,252 kPa). This pressure is commonly known as the "pop" pressure.

As the needle valve opens, fuel flows rapidly through the spray holes in the nozzle tip into the combustion chamber. After this injection, the fuel pressure drops and the needle valve is closed preventing further fuel flow, and conversely, exhaust flow into the injector.

REMOVAL & INSTALLATION

➧ See Figures 40, 41, 42, 43 and 44

1. Disconnect the negative battery cable. Remove the throttle linkage and bracket if necessary.
2. Disconnect the high pressure fuel supply line to the injector.
3. Disconnect the fuel drain manifold.
4. Clean the area around the injector.

➡Certain types of injectors MAY have an O-ring located above the hold-down nut.

5. Using the correct deepwell socket, remove the injector from the cylinder head.

To install:

6. Clean the injector bore with a bore brush.
7. Assemble the injector and 1 new copper sealing washer. Never use more than 1 copper washer.
8. Apply a thin coat of anti-seize compound to the threads of the injector hold-down nut and between the top of the nut and the injector body.
9. Align the protrusion in the injector with the notch in the bore and install the injector. Tighten the injector retainer nut to 44 ft. lbs. (60 Nm).
10. Push the O-ring into the groove at the top of the injector, if applicable.
11. Using new sealing washers, assemble the fuel drain manifold and high pressure lines. Tighten the banjo fitting bolt to 6 ft. lbs. (8 Nm). Leave the high pressure line loose temporarily.

✲✲ CAUTION

Do not place any part of the hand near the base of the high pressure line. A fuel leak from a high pressure fuel line has sufficient pressure to penetrate the skin and cause serious bodily harm. Do not bleed the lines if the engine is hot. Fuel spilling onto a hot exhaust manifold creates the danger of fire.

12. To bleed air from the system, run or crank the engine and tighten the fitting after the air has expelled. If more than 1 injector was replaced, tighten each fitting after the air has expelled before going on to the next injector fitting. Tighten the fittings for 1989–93 models to 18 ft. lbs. (24 Nm) and 1994–96 models to 22 ft. lbs. (30 Nm). The operation is complete when the engine runs smoothly. If the air cannot be removed, check the pump and supply line for suction leaks.
13. Install the throttle linkage and bracket if they were removed.

TESTING

➧ See Figures 45 and 46

✲✲ CAUTION

If examining for leaks, use a sheet of cardboard to show any spraying fuel. Do not use your hand and wear safety goggles. The extremely high pressure can cause serious personal injury, especially to your skin and eyes.

A leaking fuel injector can cause fuel knock, poor performance, black smoke, poor fuel economy and rough engine idle. If the needle valve does not operate properly, the engine may misfire and produce low power.

A leak in the injection pump-to-injector high-pressure fuel line can cause many of the same symptoms as a malfunctioning injector. First check the lines before the injectors.

1. To check the injectors, start the engine and loosen the high-pressure line nut one-at-a-time at each injector. Listen for a decrease in engine speed.

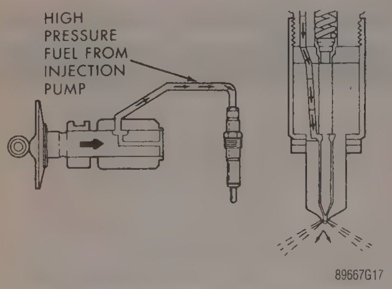

HIGH PRESSURE FUEL FROM INJECTION PUMP
89667G17

Fig. 39 The injector is a precise one-way valve that sprays a metered amount of fuel at high pressure into the combustion chamber

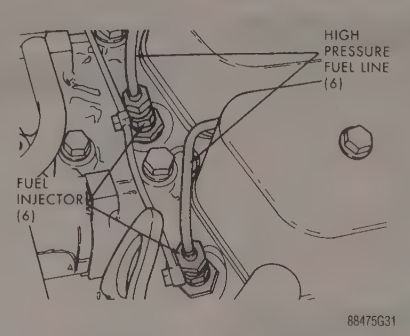

HIGH PRESSURE FUEL LINE (6)
FUEL INJECTOR (6)
88475G31

Fig. 40 Fuel is supplied to the six diesel fuel injectors by individual high pressure lines

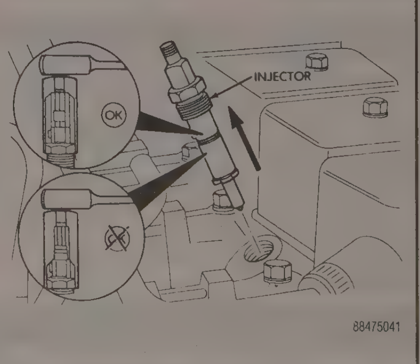

INJECTOR
OK
88475041

Fig. 41 Unscrew and remove the diesel fuel injector

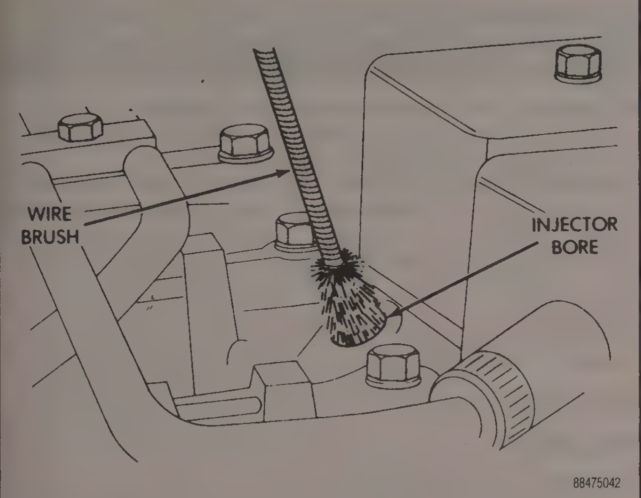


Fig. 42 Use a wire brush to clean the injector bore as shown

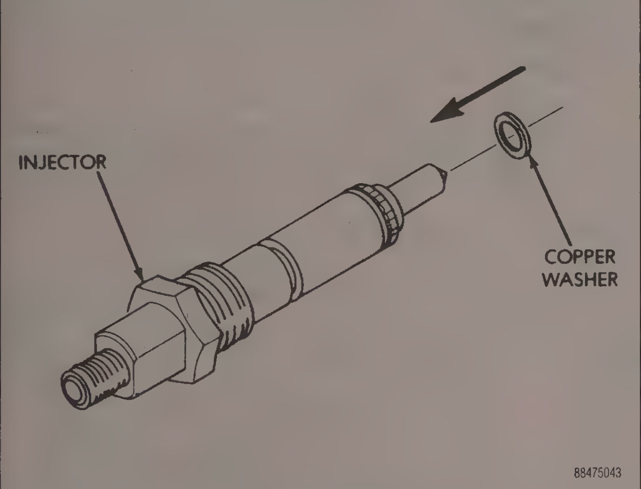


Fig. 43 Use only one copper washer on the diesel injector

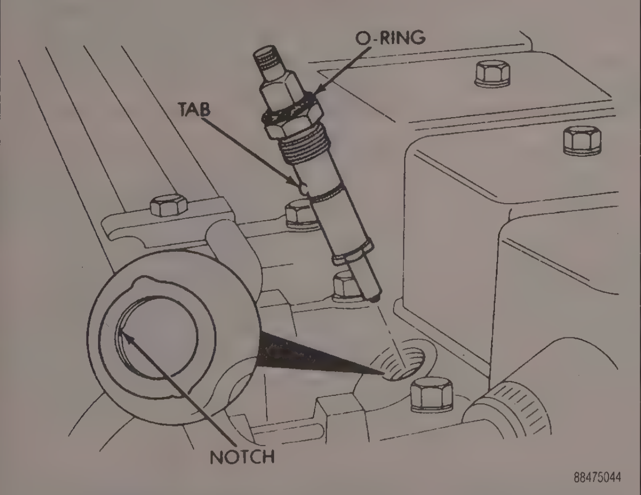


Fig. 44 Install the diesel injector so that its tab is aligned with the notch in the bore

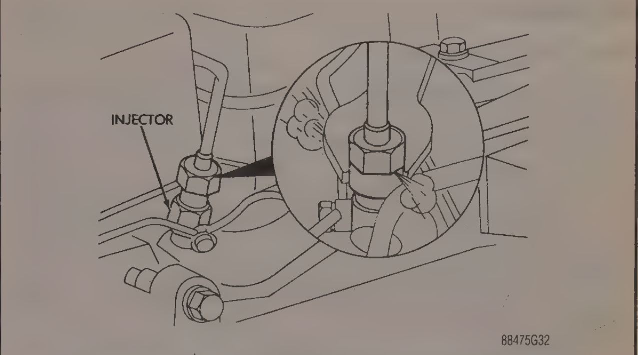


Fig. 45 Loosen the fittings one at a time, to check the effect on engine rpm—no change in rpm indicates a faulty injector

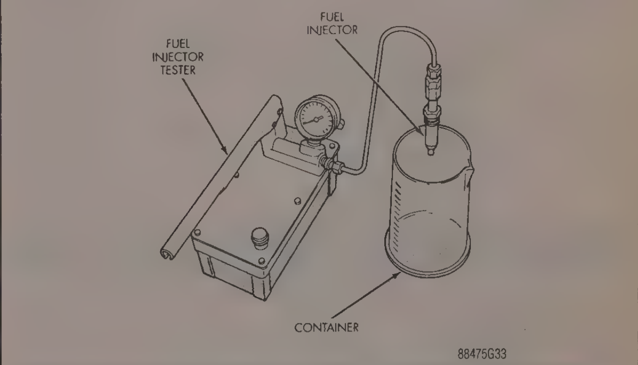


Fig. 46 Use a tester like the one shown to measure pop pressure for the diesel fuel injector

2. If the engine speed drops, the injector is operating normally. If the engine speed remains the same, the injector is malfunctioning. After testing each injector, tighten the line nuts for 1989–93 models to 18 ft. lbs. (24 Nm) and 1994–96 models to 22 ft. lbs. (30 Nm).

3. If an injector is found to be malfunctioning, remove it and test it on a standard bench-mount injector tester. Follow the manufacturer's instructions for bench testing the injector.

4. If the opening (pop) pressure is below specifications, replace the injector. For 1989–93 models, this pressure is 3,550 psi (24,445 kPa). For 1994–96 models, the pop pressure is 3,822 psi (26,252 kPa).

Fuel Supply Pump

REMOVAL & INSTALLATION

1989–93 Models

➧ See Figures 47 and 48

The mechanical lift pump is located on the left side of the cylinder block. This design is operated by a lever which rides on an eccentric on the camshaft.

The pump housing has a weep hole at the bottom. If the diaphragm inside the pump ruptures, the weep hole will leak fuel and the pump must be replaced. The lift pump is not serviceable and must be replaced as a complete unit.

On the pump is a manual lever meant to prime the fuel system and bleed air from the system if the vehicle has run out of fuel. During pump operation, the lever must be in the UP position.

1. Disconnect the negative battery cable.
2. Disconnect the low pressure fuel lines from the pump.
3. Remove the pump mounting screws, then remove the pump.
4. Installation is the reverse of removal. Secure the pump screws to 18 ft. lbs. (24 Nm).
5. Manually bleed the system of air and test the system.

1994–96 Models

See Figures 49 and 50

The fuel transfer pump is located on the left side of the engine and above the starter motor.

1. Disconnect both negative battery cables.
2. Remove the starter motor.
3. Place a drain pan beneath the pump.
4. Remove the fuel line fittings at the top of both the fuel pump and fuel heater housing.
5. Remove the fuel hose clamps and rubber fuel hose.
6. Unfasten the mounting bolts, then remove the fuel pump and fuel heater assembly from the engine as one unit.

To install:

7. Clean the mating surfaces of the fuel heater mounting bracket, the fuel pump and the engine block of any gasket material.
8. Position the new gaskets, the fuel heater housing mounting bracket and the fuel pump to the engine.
9. Install the bolts, tightening them ALTERNATELY to 18 ft. lbs. (24 Nm).

WARNING

As these bolts are tightened, the fuel pump plunger will be compressed. Tighten the fuel pump mounting bolts alternately to prevent damage to the fuel pump housing.

10. Install the fuel line fittings to the pump and fuel heater, tightening them to 18 ft. lbs. (24 Nm).
11. Install the starter motor, connect the negative battery cables and bleed the fuel system of air.

LOW PRESSURE BLEEDING

1989–93 Models

See Figure 51

1. Place a drain pan under the separator filter.
2. Open the low pressure bleed screw.
3. Manual pump the lever on the fuel pump until the fuel exiting the bleed screw is free of air. If the manual lever feels as if it is not pumping, rotate (crank) the engine approximately 90°, then continue pumping as described.
4. Tighten the low pressure bleed screw to 6 ft. lbs. (8 Nm).

1994–96 Models

See Figures 52 and 53

1. Loosen the low pressure bleed bolt.
2. Operate the rubber push-button primer on the fuel transfer pump. Do this until the fuel exiting the bleed screw is free of air. If the primer button feels as if it is not pumping, rotate (crank) the engine approximately 90°, then continue pumping as described.
3. Tighten the low pressure bleed screw to 6 ft. lbs. (8 Nm).

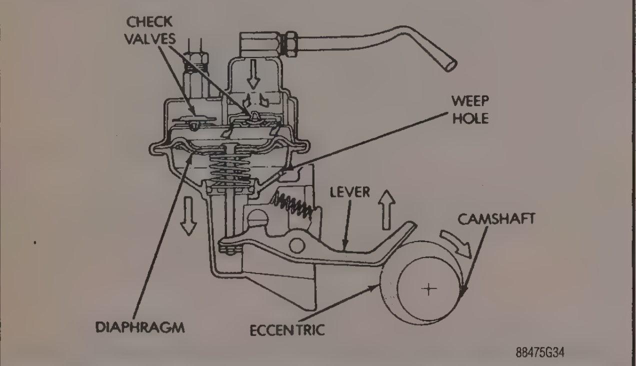

CHECK VALVES
WEEP HOLE
LEVER
CAMSHAFT
DIAPHRAGM
ECCENTRIC
88475G34

Fig. 47 Cutaway view of the mechanical lift pump—1989–93 models

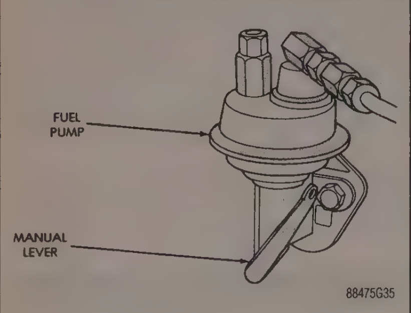

FUEL PUMP
MANUAL LEVER
88475G35

Fig. 48 The manual lever on the pump must be in the UP position when the vehicle is operated—1989–93 models

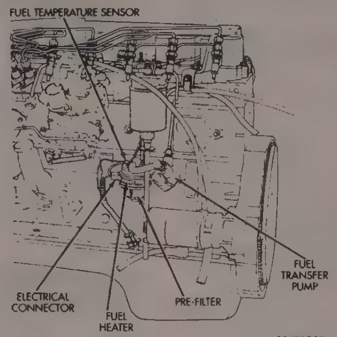

FUEL TEMPERATURE SENSOR
FUEL TRANSFER PUMP
ELECTRICAL CONNECTOR
FUEL HEATER
PRE-FILTER
88475G37

Fig. 49 Details of the fuel transfer pump mounting—1994–96 models

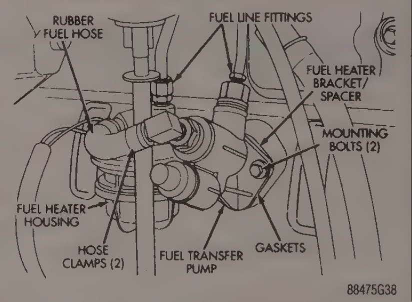

RUBBER FUEL HOSE
FUEL LINE FITTINGS
FUEL HEATER BRACKET/ SPACER
MOUNTING BOLTS (2)
FUEL HEATER HOUSING
HOSE CLAMPS (2)
FUEL TRANSFER PUMP
GASKETS
88475G38

Fig. 50 Disconnect the fuel lines and the rubber hose, then unbolt and remove the fuel pump and heater housing as a unit—1994–96 models

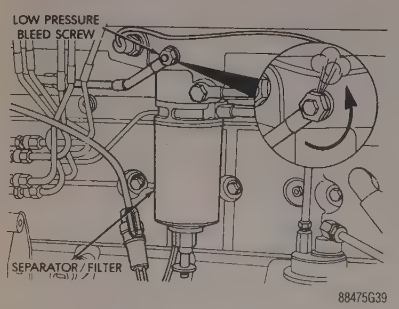

LOW PRESSURE BLEED SCREW
SEPARATOR / FILTER
88475G39

Fig. 51 Turn the low pressure bleed screw and work the lever to purge the lines of air—1989–93 models

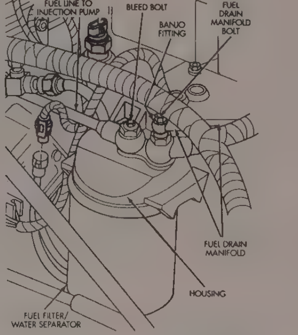

FUEL LINE TO INJECTION PUMP
BLEED BOLT
BANJO FITTING
FUEL DRAIN MANIFOLD BOLT
FUEL DRAIN MANIFOLD
HOUSING
FUEL FILTER/ WATER SEPARATOR
88475G40

Fig. 52 Location of the low pressure bleed bolt—1994–96 models

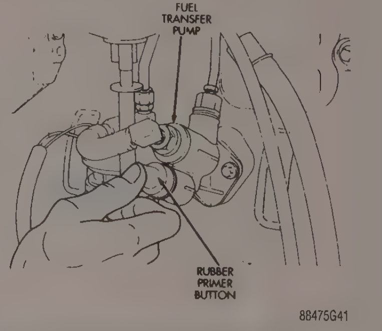

FUEL TRANSFER PUMP
RUBBER PRIMER BUTTON
88475G41

Fig. 53 Repeatedly press the rubber primer button to bleed the system of air—1994–96 models

Diesel Injection Pump

REMOVAL & INSTALLATION

▸ See Figures 54 thru 60

➡The Bosch VE lever is indexed to the shaft during pump calibration. Do not remove it from the pump during removal.

1. Disconnect the negative battery cable.
2. Remove the throttle linkage and bracket.
3. Disconnect the fuel drain manifold.
4. Remove the injection pump supply line.
5. Remove the high pressure lines.
6. Disconnect the electrical wire to the fuel shut off valve.
7. Remove the fuel air control tube.
8. Remove the pump support bracket.
9. Remove the oil fill tube bracket and adapter from the front gear cover.
10. Place a shop towel in the gear cover opening in a position that will prevent the nut and washer from falling into the gear housing. Remove the gear retaining nut and washer.
11. Install the turning tool into the flywheel housing opening on the exhaust side of the engine. Place a ½ in. drive universal joint in the turning tool and attach enough extensions to the joint to make it convenient to turn the tool.
12. Using a ratchet to turn the barring tool, turn the engine until the keyway on the fuel pump shaft is pointing approximately in the six o'clock position.
13. Locate TDC for cylinder No. 1 by turning the engine slowly while pushing in on the TDC pin. Stop turning the engine as soon as the pin engages with the gear timing hole. Disengage the pin after locating TDC and remove the turning equipment.
14. Loosen the lockscrew, remove the special washer from the injection pump and wire it to the line above it so it will not get misplaced. Retighten the lockscrew to 22 ft. lbs. (30 Nm) to lock the driveshaft.
15. Using a suitable puller, pull the pump drive gear from the driveshaft.

➡Be careful not to drop the drive gear key into the front cover when removing or installing the pump. If it does drop in, it must be removed before proceeding.

16. Remove the 3 mounting nuts and remove the injection pump from the vehicle.
17. Remove the gasket and clean the mounting surface.

To install:

18. Install a new gasket.

➡The shaft of a new or reconditioned pump is locked so the key aligns with the drive gear keyway with cylinder No. 1 at TDC.

19. Install the pump and finger-tighten the mounting nuts; the pump must be free to move in the slots.
20. Install the pump drive gear, washer and nut to the driveshaft. The pump will rotate slightly because of gear helix and clearance. This is acceptable providing the pump is free to move on the flange slots and the crankshaft does not move. Tighten the nut to 11–15 ft. lbs. (15–20 Nm). This is not the final torque; do not overtighten.
21. If installing the original pump, rotate the pump to align the original timing marks and tighten the mounting nuts to 18 ft. lbs. (24 Nm).
22. If installing a replacement pump, take up gear lash by rotating the pump counterclockwise toward the cylinder head, and tighten the mounting nuts to 18 ft. lbs. (24 Nm). Permanently mark the new injection pump flange to match the mark on the gear housing.
23. Loosen the lockscrew and install the special washer under the lockscrew; tighten to 13 ft. lbs. (18 Nm). Disengage the TDC pin.
24. Install the injection pump support bracket. Finger-tighten the bolts initially, then tighten them to 18 ft. lbs. (24 Nm) in the following sequence:
    a. Bracket to block bolts.
    b. Bracket to injection pump bolts.
    c. Throttle support bracket bolts.
25. Now perform the final tighten of the pump drive gear retaining nut to 48 ft. lbs. (65 Nm).
26. Install the oil filler tube assembly and clamp. Tighten the bolts to 32 ft. lbs. (43 Nm).
27. Install all fuel lines and the electrical connector to the fuel shut off valve. Tighten the high pressure lines to 18 ft. lbs. (24 Nm).
28. Install the fuel air control tube. Tighten the banjo fitting bolt to 9 ft. lbs. (12 Nm).
29. Install the throttle bracket and linkage. When connecting the cable to the control lever, adjust the length so the lever has stop-to-stop movement.
30. Connect the negative battery cable.

✱✱ CAUTION

Do not place any part of the hand near the base of the high pressure line. A fuel leak from a high pressure fuel line has sufficient pressure to penetrate the skin and cause serious bodily harm. Do not bleed the lines if the engine is hot. Fuel spilling onto a hot exhaust manifold creates the danger of fire.

31. To bleed air from the system, run or crank the engine and carefully loosen the high pressure fitting from each injector one at a time. Retighten the fitting after the air has expelled before going on to the next injector fitting. The operation is complete when the engine runs smoothly. If the air cannot be removed, check the pump and supply line for suction leaks.
32. Adjust the idle speed if necessary.

INJECTION PUMP TIMING

▸ See Figures 57, 61 thru 65

1. Install the barring tool into the flywheel housing opening on the exhaust side of the engine. Place a ½ in. drive universal joint in the tool and attach enough extensions to the joint to make it convenient to turn the tool.
2. Using a ratchet to turn the barring tool, turn the engine until the keyway on the fuel pump shaft is pointing approximately in the six o'clock position.

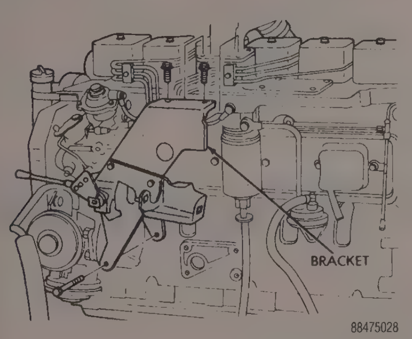


Fig. 54 Remove the throttle linkage and bracket from the engine

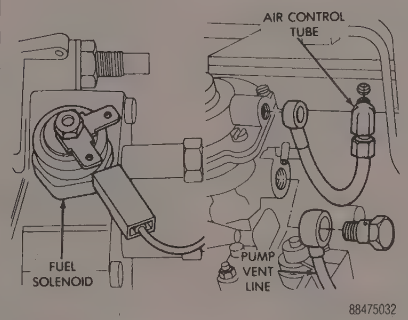


Fig. 55 Detach the connector and lines shown when removing the injection pump

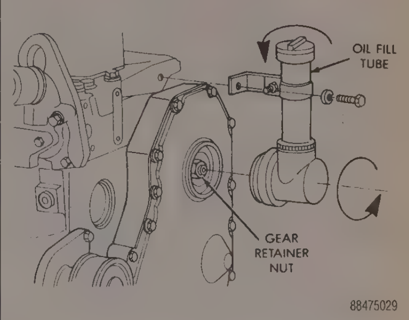


Fig. 56 Exploded view of the oil fill tube and bracket

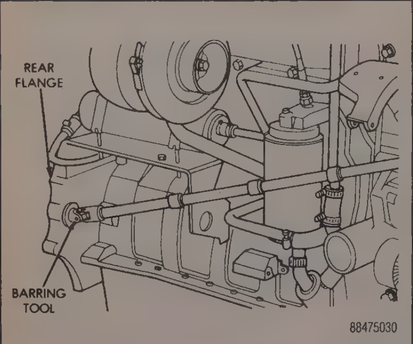

REAR FLANGE
BARRING TOOL
88475030

Fig. 57 Use the barring tool to rotate the diesel engine

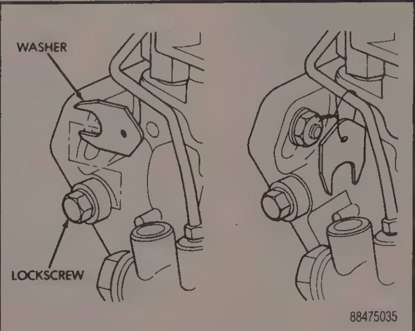

WASHER
LOCKSCREW
88475035

Fig. 58 Loosen the injection pump shaft lockscrew and remove the special washer shown

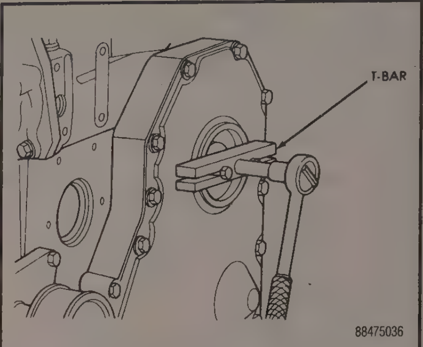

T-BAR
88475036

Fig. 59 Use a puller tool as shown to remove the injection pump timing gear

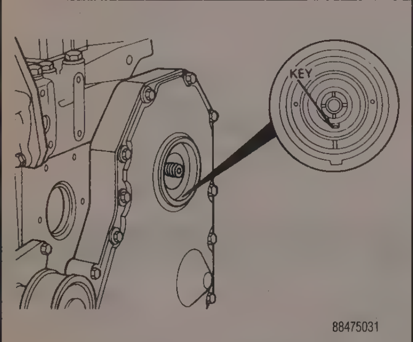

KEY
88475031

Fig. 60 Be careful not to lose the injection pump key

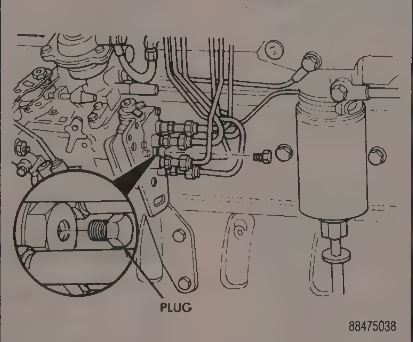

PLUG
88475038

Fig. 61 Location of the injection pump timing indicator plug

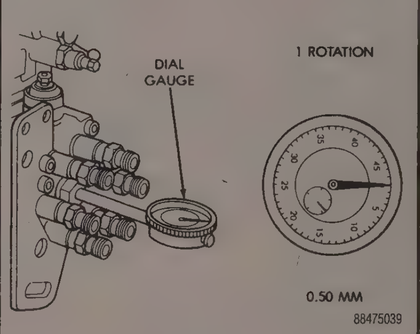

DIAL GAUGE
1 ROTATION
0.50 MM
88475039

Fig. 62 Check the injection pump timing with the timing gauge installed

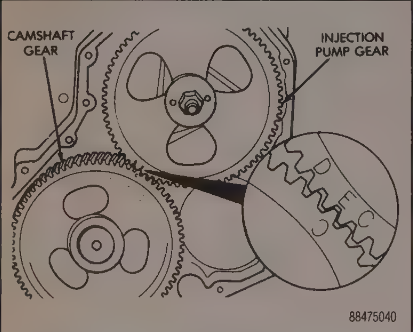

CAMSHAFT GEAR
INJECTION PUMP GEAR
88475040

Fig. 63 Injection pump timing gear alignment

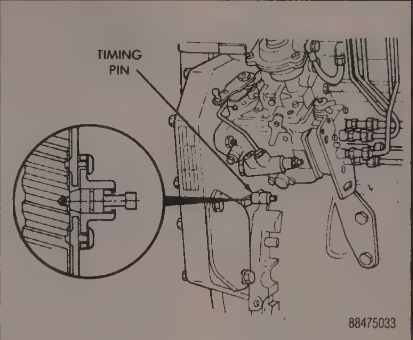

TIMING PIN
88475033

Fig. 64 Location of the timing pin

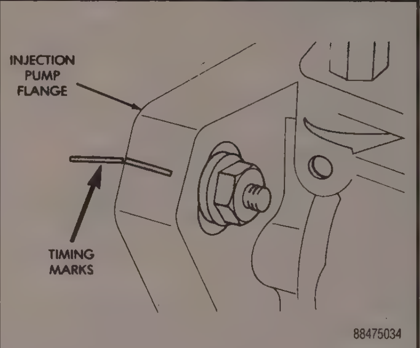

INJECTION PUMP FLANGE
TIMING MARKS
88475034

Fig. 65 Injection pump timing marks

3. Locate TDC for cylinder No. 1 by turning the engine slowly while pushing in on the TDC pin. Stop turning the engine as soon as the pin engages with the gear timing hole. Disengage the pin after locating TDC.
4. Remove the plug from the end of the pump.
5. Install the special timing indicator, allowing for adequate indicator pin travel. It may be necessary to disconnect one or more fuel lines to properly install the indicator.

➥The indicator is marked in increments of 0.01mm. One revolution of the indicator needle is equal to 0.050mm.

6. Turn the engine counterclockwise until the indicator needle stops moving. Adjust the indicator face to read zero.
7. Rotate the engine back to TDC and count the number of revolutions of the indicator needle. The reading shown when the engine timing pin engages is the amount of the pump's plunger lift at that point.
8. Readjust the indicator face to read zero. Loosen the pump mounting nuts and rotate the pump clockwise toward the cylinder head until the indicator reads the correct value for plunger lift (the reading in Step 7). Tighten the mounting nuts to 18 ft. lbs. (24 Nm).
9. Remove the engine turning equipment and timing indicator. Install the timing plug and tighten to 7.5 ft. lbs. (10 Nm). Connect any fuel lines that were disconnected.
10. Road test the vehicle.

Fuel/Water Separator Filter

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Disconnect the Water In Filter (WIF) sensor connector.
3. Remove the separator filter assembly from the filter head with a standard oil filter wrench.
4. Remove the square cut O-ring from the filter mounting bushing.

5. Drain the fuel/water separator filter and remove the assembly from the fuel filter.
6. Installation is the reverse of removal. Apply a light coat of oil to the sealing surface of the separator filter. Install the assembly and tighten it ½ turn after the seal contacts the filter head.
7. Connect the negative battery cable, start the engine and check for leaks.

DRAINING WATER FROM THE SYSTEM

Filtration and separation of water from the fuel is important for trouble free operation and long life of the fuel system. Regular maintenance, including draining moisture from the fuel/water separator filter is essential to keep water out of the fuel pump. To remove the collected water, simply unscrew the drain at the bottom of the WIF assembly located at the bottom of the filter separator.

Idle Speed Adjustment

See Figure 66

1. Start the engine and run until at normal operating temperature.

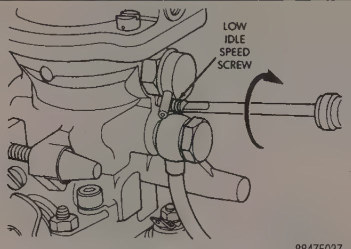

LOW IDLE SPEED SCREW
88475037

Fig. 66 Turn the screw shown to adjust the low idle speed

2. An optical tachometer must be used to read engine speed; a conventional tachometer connected to the coil is useless in this instance.
3. Turn the air conditioning **ON**, if equipped.
4. Turn the idle speed screw until the desired idle speed is obtained. The specification for a vehicle equipped with automatic transmission is 700 rpm. The specification for a vehicle equipped with manual transmission is 750 rpm.

FUEL TANK

Tank Assembly

REMOVAL & INSTALLATION

Pick-Ups

See Figures 67, 68 and 69

1. Disconnect the battery ground cable.
2. Remove the fuel tank filler cap.
3. Raise the vehicle on a lift. Pump all fuel from the tank into an approved holding tank, and raise the vehicle.
4. Disconnect the fuel line and wire lead to the gauge unit. Remove the ground strap.
5. Remove the vent hose shield and the hose clamps from the hoses running to the vapor vent tube.
6. Remove the filler tube hose clamps and disconnect the hose from the tank.
7. Place a transmission jack under the center of the tank and apply sufficient pressure to support the tank.
8. Disconnect the two J-bolts and remove the retaining straps at the rear of the tank. Lower the tank from the vehicle. Feed the two vent tube hoses and filler tube vent hose through the grommets in the frame as the tank is being lowered. Remove the tank gauge unit.

To install:

9. Inspect the fuel filter, and if it is clogged or damaged, replace it.
10. Insert a new gasket in the recess of the fuel gauge and slide the gauge into the tank. Align the positioning tangs on the gauge with those on the tank. Install the lock ring and tighten securely.

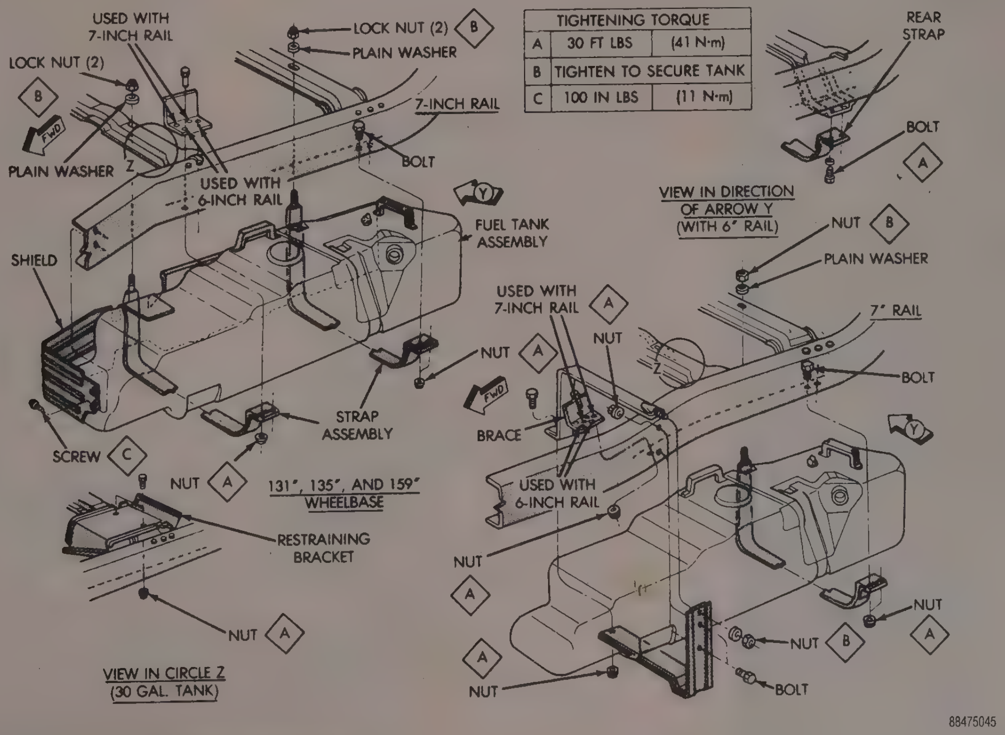

USED WITH 7-INCH RAIL
LOCK NUT (2)
B
FWD
PLAIN WASHER
Z
LOCK NUT (2) B
PLAIN WASHER
7-INCH RAIL
BOLT
USED WITH 6-INCH RAIL
TIGHTENING TORQUE
A 30 FT LBS (41 N·m)
B TIGHTEN TO SECURE TANK
C 100 IN LBS (11 N·m)
REAR STRAP
BOLT
A
VIEW IN DIRECTION OF ARROW Y (WITH 6" RAIL)
Y
FUEL TANK ASSEMBLY
SHIELD
NUT B
PLAIN WASHER
USED WITH 7-INCH RAIL A
7" RAIL
NUT
NUT A
BOLT
STRAP ASSEMBLY
FWD
BRACE
Y
SCREW C
NUT A
131", 135", AND 159" WHEELBASE
USED WITH 6-INCH RAIL
RESTRAINING BRACKET
NUT A
NUT
NUT A
NUT B
NUT A
BOLT
VIEW IN CIRCLE Z (30 GAL. TANK)
88475045

Fig. 67 Common components of the mid-frame mounted fuel tank

11. Position the tank on a transmission jack and hoist it into place, feeding the vent hoses through the grommets on the way up.
12. Connect the J-bolts and retaining straps, and tighten to 40 inch lbs. (4.5 Nm). Remove the jack.
13. Connect the filler tube and all vent hoses.
14. Connect the fuel supply line, ground strap, and gauge unit wire lead.
15. Refill the tank and inspect it for leaks. Connect the battery ground cable.

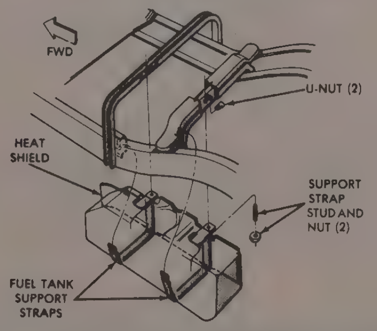

FWD
U-NUT (2)
HEAT SHIELD
SUPPORT STRAP STUD AND NUT (2)
FUEL TANK SUPPORT STRAPS
88475049

Fig. 68 The fuel tank is mounted to the frame rail as shown—Dakota models

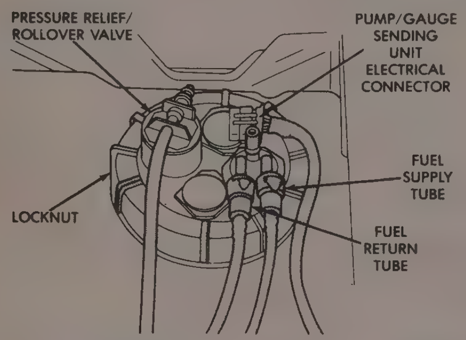

PRESSURE RELIEF/ ROLLOVER VALVE
PUMP/GAUGE SENDING UNIT ELECTRICAL CONNECTOR
FUEL SUPPLY TUBE
LOCKNUT
FUEL RETURN TUBE
88475046

Fig. 69 Disconnect the fuel pump module lines when removing the tank

Ramcharger

➧ See Figure 70

1. If there is a tank skid plate, remove it.
2. Disconnect the battery ground cable.
3. Remove the tank filler cap.
4. Pump or siphon the contents of the tank into a safe container.

CAUTION

Siphoning should not be started by mouth! Only fuel-safe pumps should be used.

5. Raise the vehicle on a hoist and disconnect the fuel line and tank sending unit wire. Remove the ground strap or wire.
6. Remove the hose clamps from the vent dome hose.
7. Remove the filler tube hose clamps. Detach the hoses from the tank.
8. Support the tank with a padded transmission jack.
9. Disconnect the two J-bolts and remove the straps at the rear of the tank.
10. Remove the tank gauge sending unit.
11. Installation is the reverse of removal.

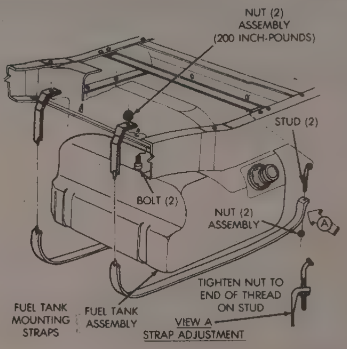

NUT (2) ASSEMBLY (200 INCH-POUNDS)
STUD (2)
BOLT (2)
NUT (2) ASSEMBLY
A
TIGHTEN NUT TO END OF THREAD ON STUD
FUEL TANK MOUNTING STRAPS
FUEL TANK ASSEMBLY
VIEW A STRAP ADJUSTMENT
88475048

Fig. 70 Details of the Ramcharger fuel tank mounting

TORQUE SPECIFICATIONS

Component	English	Metric
Fuel filter:	75 inch lbs.	8 Nm
Throttle body mounting bolts:	175 inch lbs.	20 Nm
Throttle body fuel fittings:	175 inch lbs.	20 Nm
Throttle body temperature sensor:	110 inch lbs.	12 Nm
Fuel pressure regulator:	40 inch lbs.	5 Nm
Fuel injector clamp:	35 inch lbs.	4 Nm
Throttle position sensor:	27 inch lbs.	3 Nm
Throttle body vacuum manifold:	35 inch lbs.	4 Nm
Oxygen sensor:	20 ft. lbs.	27 Nm

88475C06

6

CHASSIS ELECTRICAL

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UNDERSTANDING AND TROUBLESHOOTING ELECTRICAL SYSTEMS

Basic Electrical Theory

See Figure 1

For any 12 volt, negative ground, electrical system to operate, the electricity must travel in a complete circuit. This simply means that current (power) from the positive (+) terminal of the battery must eventually return to the negative (-) terminal of the battery. Along the way, this current will travel through wires, fuses, switches and components. If, for any reason, the flow of current through the circuit is interrupted, the component fed by that circuit will cease to function properly.

Perhaps the easiest way to visualize a circuit is to think of connecting a light bulb (with two wires attached to it) to the battery—one wire attached to the negative (-) terminal of the battery and the other wire to the positive (+) terminal. With the two wires touching the battery terminals, the circuit would be complete and the light bulb would illuminate. Electricity would follow a path from the battery to the bulb and back to the battery. It's easy to see that with longer wires on our light bulb, it could be mounted anywhere. Further, one wire could be fitted with a switch so that the light could be turned on and off.

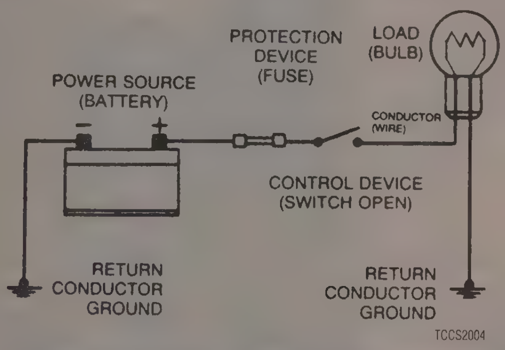


Fig. 1 This example illustrates a simple circuit. When the switch is closed, power from the positive (+) battery terminal flows through the fuse and the switch, and then to the light bulb. The light illuminates and the circuit is completed through the ground wire back to the negative (-) battery terminal. In reality, the two ground points shown in the illustration are attached to the metal frame of the vehicle, which completes the circuit back to the battery

The normal automotive circuit differs from this simple example in two ways. First, instead of having a return wire from the bulb to the battery, the current travels through the frame of the vehicle. Since the negative (-) battery cable is attached to the frame (made of electrically conductive metal), the frame of the vehicle can serve as a ground wire to complete the circuit. Secondly, most automotive circuits contain multiple components which receive power from a single circuit. This lessens the amount of wire needed to power components on the vehicle.

HOW DOES ELECTRICITY WORK: THE WATER ANALOGY

Electricity is the flow of electrons—the subatomic particles that constitute the outer shell of an atom. Electrons spin in an orbit around the center core of an atom. The center core is comprised of protons (positive charge) and neutrons (neutral charge). Electrons have a negative charge and balance out the positive charge of the protons. When an outside force causes the number of electrons to unbalance the charge of the protons, the electrons will split off the atom and look for another atom to balance out. If this imbalance is kept up, electrons will continue to move and an electrical flow will exist.

Many people have been taught electrical theory using an analogy with water. In a comparison with water flowing through a pipe, the electrons would be the water and the wire is the pipe.

The flow of electricity can be measured much like the flow of water through a pipe. The unit of measurement used is amperes, frequently abbreviated as amps (a). You can compare amperage to the volume of water flowing through a pipe. When connected to a circuit, an ammeter will measure the actual amount of current flowing through the circuit. When relatively few electrons flow through a circuit, the amperage is low. When many electrons flow, the amperage is high.

Water pressure is measured in units such as pounds per square inch (psi); The electrical pressure is measured in units called volts (v). When a voltmeter is connected to a circuit, it is measuring the electrical pressure.

The actual flow of electricity depends not only on voltage and amperage, but also on the resistance of the circuit. The higher the resistance, the higher the force necessary to push the current through the circuit. The standard unit for measuring resistance is an ohm. Resistance in a circuit varies depending on the amount and type of components used in the circuit. The main factors which determine resistance are:

- Material—some materials have more resistance than others. Those with high resistance are said to be insulators. Rubber materials (or rubber-like plastics) are some of the most common insulators used in vehicles as they have a very high resistance to electricity. Very low resistance materials are said to be conductors. Copper wire is among the best conductors. Silver is actually a superior conductor to copper and is used in some relay contacts, but its high cost prohibits its use as common wiring. Most automotive wiring is made of copper.
- Size—the larger the wire size being used, the less resistance the wire will have. This is why components which use large amounts of electricity usually have large wires supplying current to them.
- Length—for a given thickness of wire, the longer the wire, the greater the resistance. The shorter the wire, the less the resistance. When determining the proper wire for a circuit, both size and length must be considered to design a circuit that can handle the current needs of the component.
- Temperature—with many materials, the higher the temperature, the greater the resistance (positive temperature coefficient). Some materials exhibit the opposite trait of lower resistance with higher temperatures (negative temperature coefficient). These principles are used in many of the sensors on the engine.

OHM'S LAW

There is a direct relationship between current, voltage and resistance. The relationship between current, voltage and resistance can be summed up by a statement known as Ohm's law.

Voltage (E) is equal to amperage (I) times resistance (R): $E=I \times R$

Other forms of the formula are $R=E/I$ and $I=E/R$

In each of these formulas, E is the voltage in volts, I is the current in amps and R is the resistance in ohms. The basic point to remember is that as the resistance of a circuit goes up, the amount of current that flows in the circuit will go down, if voltage remains the same.

The amount of work that the electricity can perform is expressed as power. The unit of power is the watt (w). The relationship between power, voltage and current is expressed as:

Power (w) is equal to amperage (I) times voltage (E): $W=I \times E$

This is only true for direct current (DC) circuits; The alternating current formula is a tad different, but since the electrical circuits in most vehicles are DC type, we need not get into AC circuit theory.

Electrical Components

POWER SOURCE

Power is supplied to the vehicle by two devices: The battery and the alternator. The battery supplies electrical power during starting or during periods when the current demand of the vehicle's electrical system exceeds the output capacity of the alternator. The alternator supplies electrical current when the engine is running. Just not does the alternator supply the current needs of the vehicle, but it recharges the battery.

The Battery

In most modern vehicles, the battery is a lead/acid electrochemical device consisting of six 2 volt subsections (cells) connected in series, so that the unit is capable of producing approximately 12 volts of electrical pressure. Each subsection consists of a series of positive and negative plates held a short distance apart in a solution of sulfuric acid and water.

The two types of plates are of dissimilar metals. This sets up a chemical reaction, and it is this reaction which produces current flow from the battery when its positive and negative terminals are connected to an electrical load . The power removed from the battery is replaced by the alternator, restoring the battery to its original chemical state.

The Alternator

On some vehicles there isn't an alternator, but a generator. The difference is that an alternator supplies alternating current which is then changed to direct current for use on the vehicle, while a generator produces direct current. Alternators tend to be more efficient and that is why they are used.

Alternators and generators are devices that consist of coils of wires wound together making big electromagnets. One group of coils spins within another set and the interaction of the magnetic fields causes a current to flow. This current is then drawn off the coils and fed into the vehicles electrical system.

GROUND

Two types of grounds are used in automotive electric circuits. Direct ground components are grounded to the frame through their mounting points. All other components use some sort of ground wire which is attached to the frame or chassis of the vehicle. The electrical current runs through the chassis of the vehicle and returns to the battery through the ground (-) cable; if you look, you'll see that the battery ground cable connects between the battery and the frame or chassis of the vehicle.

➡It should be noted that a good percentage of electrical problems can be traced to bad grounds.

PROTECTIVE DEVICES

➧ See Figure 2

It is possible for large surges of current to pass through the electrical system of your vehicle. If this surge of current were to reach the load in the circuit, the surge could burn it out or severely damage it. It can also overload the wiring, causing the harness to get hot and melt the insulation. To prevent this, fuses, circuit breakers and/or fusible links are connected into the supply wires of the electrical system. These items are nothing more than a built-in weak spot in the system. When an abnormal amount of current flows through the system, these protective devices work as follows to protect the circuit:

- Fuse—when an excessive electrical current passes through a fuse, the fuse "blows" (the conductor melts) and opens the circuit, preventing the passage of current.
- Circuit Breaker—a circuit breaker is basically a self-repairing fuse. It will open the circuit in the same fashion as a fuse, but when the surge subsides, the circuit breaker can be reset and does not need replacement.
- Fusible Link—a fusible link (fuse link or main link) is a short length of special, high temperature insulated wire that acts as a fuse. When an excessive electrical current passes through a fusible link, the thin gauge wire inside the link melts, creating an intentional open to protect the circuit. To repair the circuit, the link must be replaced. Some newer type fusible links are housed in plug-in modules, which are simply replaced like a fuse, while older type fusible links must be cut and spliced if they melt. Since this link is very early in the electrical path, it's the first place to look if nothing on the vehicle works, yet the battery seems to be charged and is properly connected.

TCCA6P01

Fig. 2 Most vehicles use one or more fuse panels. This one is located on the driver's side kick panel

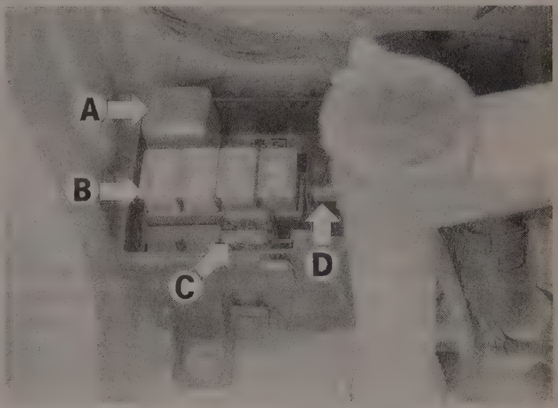
✲✲✲ CAUTION

Always replace fuses, circuit breakers and fusible links with identically rated components. Under no circumstances should a component of higher or lower amperage rating be substituted.

SWITCHES & RELAYS

➧ See Figures 3 and 4

Switches are used in electrical circuits to control the passage of current. The most common use is to open and close circuits between the battery and the various electric devices in the system. Switches are rated according to the amount of amperage they can handle. If a sufficient amperage rated switch is not used in a circuit, the switch could overload and cause damage.



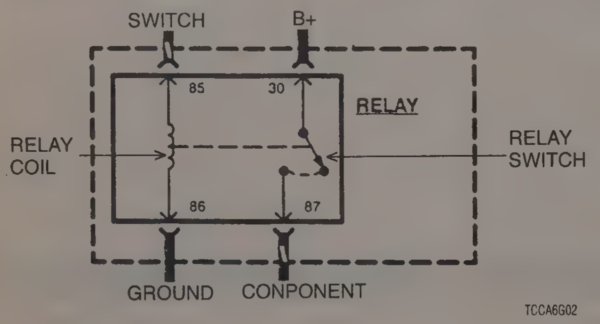
A. Relay
B. Fusible link
C. Fuse
D. Flasher

TCCA6P02

Fig. 3 The underhood fuse and relay panel usually contains fuses, relays, flashers and fusible links

Some electrical components which require a large amount of current to operate use a special switch called a relay. Since these circuits carry a large amount of current, the thickness of the wire in the circuit is also greater. If this large wire were connected from the load to the control switch, the switch would have to carry the high amperage load and the fairing or dash would be twice as large to accommodate the increased size of the wiring harness. To prevent these problems, a relay is used.

Relays are composed of a coil and a set of contacts. When the coil has a current passed though it, a magnetic field is formed and this field causes the contacts to move together, completing the circuit. Most relays are normally open, preventing current from passing through the circuit, but they can take any electrical form depending on the job they are intended to do. Relays can be considered "remote control switches." They allow a smaller current to operate devices that require higher amperages. When a small current operates the coil, a larger current is allowed to pass by the contacts. Some common circuits which may use relays are the horn, headlights, starter, electric fuel pump and other high draw ciruits.



TCCA6G02

Fig. 4 Relays are composed of a coil and a switch. These two components are linked together so that when one operates, the other operates at the same time. The large wires in the circuit are connected from the battery to one side of the relay switch (B+) and from the opposite side of the relay switch to the load (component). Smaller wires are connected from the relay coil to the control switch for the circuit and from the opposite side of the relay coil to ground

LOAD

Every electrical circuit must include a "load" (something to use the electricity coming from the source). Without this load, the battery would attempt to deliver its entire power supply from one pole to another. This is called a "short circuit." All this electricity would take a short cut to ground and cause a great amount of damage to other components in the circuit by developing a tremendous amount of heat. This condition could develop sufficient heat to melt the insulation on all the surrounding wires and reduce a multiple wire cable to a lump of plastic and copper.

WIRING & HARNESSES

The average vehicle contains meters and meters of wiring, with hundreds of individual connections. To protect the many wires from damage and to keep them from becoming a confusing tangle, they are organized into bundles, enclosed in plastic or taped together and called wiring harnesses. Different harnesses serve different parts of the vehicle. Individual wires are color coded to help trace them through a harness where sections are hidden from view.

Automotive wiring or circuit conductors can be either single strand wire, multi-strand wire or printed circuitry. Single strand wire has a solid metal core and is usually used inside such components as alternators, motors, relays and other devices. Multi-strand wire has a core made of many small strands of wire twisted together into a single conductor. Most of the wiring in an automotive electrical system is made up of multi-strand wire, either as a single conductor or grouped together in a harness. All wiring is color coded on the insulator, either as a solid color or as a colored wire with an identification stripe. A printed circuit is a thin film of copper or other conductor that is printed on an insulator backing. Occasionally, a printed circuit is sandwiched between two sheets of plastic for more protection and flexibility. A complete printed circuit, consisting of conductors, insulating material and connectors for lamps or other components is called a printed circuit board. Printed circuitry is used in place of individual wires or harnesses in places where space is limited, such as behind instrument panels.

Since automotive electrical systems are very sensitive to changes in resistance, the selection of properly sized wires is critical when systems are repaired. A loose or corroded connection or a replacement wire that is too small for the circuit will add extra resistance and an additional voltage drop to the circuit.

The wire gauge number is an expression of the cross-section area of the conductor. Vehicles from countries that use the metric system will typically describe the wire size as its cross-sectional area in square millimeters. In this method, the larger the wire, the greater the number. Another common system for expressing wire size is the American Wire Gauge (AWG) system. As gauge number increases, area decreases and the wire becomes smaller. An 18 gauge wire is smaller than a 4 gauge wire. A wire with a higher gauge number will carry less current than a wire with a lower gauge number. Gauge wire size refers to the size of the strands of the conductor, not the size of the complete wire with insulator. It is possible, therefore, to have two wires of the same gauge with different diameters because one may have thicker insulation than the other.

It is essential to understand how a circuit works before trying to figure out why it doesn't. An electrical schematic shows the electrical current paths when a circuit is operating properly. Schematics break the entire electrical system down into individual circuits. In a schematic, usually no attempt is made to represent wiring and components as they physically appear on the vehicle; switches and other components are shown as simply as possible. Face views of harness connectors show the cavity or terminal locations in all multi-pin connectors to help locate test points.

CONNECTORS

➧ See Figures 5 and 6

Three types of connectors are commonly used in automotive applications—weatherproof, molded and hard shell.

- Weatherproof—these connectors are most commonly used where the connector is exposed to the elements. Terminals are protected against moisture and dirt by sealing rings which provide a weathertight seal. All repairs require the use of a special terminal and the tool required to service it. Unlike standard blade type terminals, these weatherproof terminals cannot be straightened once they are bent. Make certain that the connectors are properly seated and all of the sealing rings are in place when connecting leads.
- Molded—these connectors require complete replacement of the connector if found to be defective. This means splicing a new connector assembly into the harness. All splices should be soldered to insure proper contact. Use care when probing the connections or replacing terminals in them, as it is possible to create a short circuit between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors for circuit checking and NEVER probe through weatherproof seals.
- Hard Shell—unlike molded connectors, the terminal contacts in hard-shell connectors can be replaced. Replacement usually involves the use of a special terminal removal tool that depresses the locking tangs (barbs) on the connector terminal and allows the connector to be removed from the rear of the shell. The connector shell should be replaced if it shows any evidence of burning, melting, cracks, or breaks. Replace individual terminals that are burnt, corroded, distorted or loose.

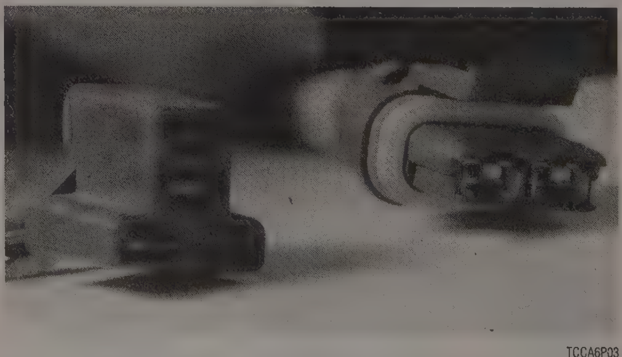


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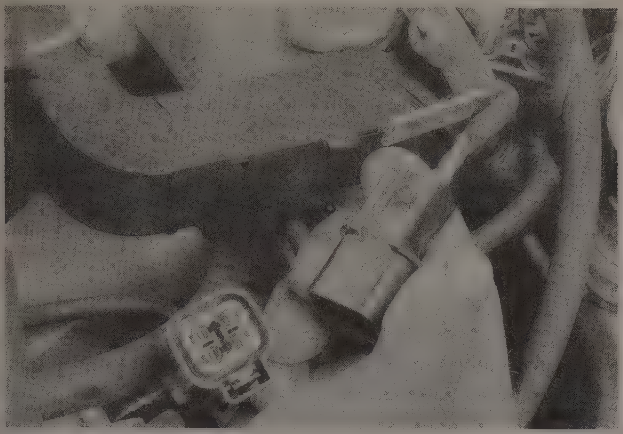
Fig. 5 Hard shell (left) and weatherproof (right) connectors have replaceable terminals



TCCA6P04

Fig. 6 Weatherproof connectors are most commonly used in the engine compartment or where the connector is exposed to the elements

Test Equipment

Pinpointing the exact cause of trouble in an electrical circuit is most times accomplished by the use of special test equipment. The following describes different types of commonly used test equipment and briefly explains how to use them in diagnosis. In addition to the information covered below, the tool manufacturer's instructions booklet (provided with the tester) should be read and clearly understood before attempting any test procedures.

JUMPER WIRES

✻✻ CAUTION

Never use jumper wires made from a thinner gauge wire than the circuit being tested. If the jumper wire is of too small a gauge, it may overheat and possibly melt. Never use jumpers to bypass high resistance loads in a circuit. Bypassing resistances, in effect, creates a short circuit. This may, in turn, cause damage and fire. Jumper wires should only be used to bypass lengths of wire or to simulate switches.

Jumper wires are simple, yet extremely valuable, pieces of test equipment. They are basically test wires which are used to bypass sections of a circuit. Although jumper wires can be purchased, they are usually fabricated from lengths of standard automotive wire and whatever type of connector (alligator clip, spade connector or pin connector) that is required for the particular application being tested. In cramped, hard-to-reach areas, it is advisable to have insulated boots over the jumper wire terminals in order to prevent accidental grounding. It is also advisable to include a standard automotive fuse in any jumper wire. This is commonly referred to as a "fused jumper". By inserting an in-line fuse holder between a set of test leads, a fused jumper wire can be used for bypassing open circuits. Use a 5 amp fuse to provide protection against voltage spikes.

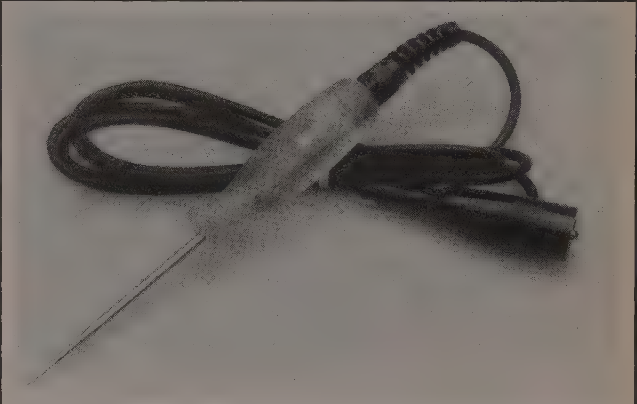
Jumper wires are used primarily to locate open electrical circuits, on either the ground (-) side of the circuit or on the power (+) side. If an electrical component fails to operate, connect the jumper wire between the component and a good ground. If the component operates only with the jumper installed, the ground circuit is open. If the ground circuit is good, but the component does not operate, the circuit between the power feed and component may be open. By moving the jumper wire successively back from the component toward the power source, you can isolate the area of the circuit where the open is located. When the component stops functioning, or the power is cut off, the open is in the segment of wire between the jumper and the point previously tested.

You can sometimes connect the jumper wire directly from the battery to the "hot" terminal of the component, but first make sure the component uses 12 volts in operation. Some electrical components, such as fuel injectors or sensors, are designed to operate on about 4 to 5 volts, and running 12 volts directly to these components will cause damage.

TEST LIGHTS

➧ See Figure 7

The test light is used to check circuits and components while electrical current is flowing through them. It is used for voltage and ground tests. To use a 12 volt test light, connect the ground clip to a good ground and probe wherever necessary with the pick. The test light will illuminate when voltage is detected. This does not necessarily mean that 12 volts (or any particular amount of voltage) is present; it only means that some voltage is present. It is advisable before using the test light to touch its ground clip and probe across the battery posts or terminals to make sure the light is operating properly.



TCCS2006

Fig. 7 A 12 volt test light is used to detect the presence of voltage in a circuit

✻✻ WARNING

Do not use a test light to probe electronic ignition, spark plug or coil wires. Never use a pick-type test light to probe wiring on computer controlled systems unless specifically instructed to do so. Any wire insulation that is pierced by the test light probe should be taped and sealed with silicone after testing.

Like the jumper wire, the 12 volt test light is used to isolate opens in circuits. But, whereas the jumper wire is used to bypass the open to operate the load, the 12 volt test light is used to locate the presence of voltage in a circuit. If the test light illuminates, there is power up to that point in the circuit; if the test light does not illuminate, there is an open circuit (no power). Move the test light in successive steps back toward the power source until the light in the handle illuminates. The open is between the probe and a point which was previously probed.

The self-powered test light is similar in design to the 12 volt test light, but contains a 1.5 volt penlight battery in the handle. It is most often used in place of a multimeter to check for open or short circuits when power is isolated from the circuit (continuity test).

The battery in a self-powered test light does not provide much current. A weak battery may not provide enough power to illuminate the test light even when a complete circuit is made (especially if there is high resistance in the circuit). Always make sure that the test battery is strong. To check the battery, briefly touch the ground clip to the probe; if the light glows brightly, the battery is strong enough for testing.

➡A self-powered test light should not be used on any computer controlled system or component. The small amount of electricity transmitted by the test light is enough to damage many electronic automotive components.

MULTIMETERS

Multimeters are an extremely useful tool for troubleshooting electrical problems. They can be purchased in either analog or digital form and have a price range to suit any budget. A multimeter is a voltmeter, ammeter and ohmmeter (along with other features) combined into one instrument. It is often used when testing solid state circuits because of its high input impedance (usually 10 megaohms or more). A brief description of the multimeter main test functions follows:

- Voltmeter—the voltmeter is used to measure voltage at any point in a circuit, or to measure the voltage drop across any part of a circuit. Voltmeters usually have various scales and a selector switch to allow the reading of different voltage ranges. The voltmeter has a positive and a negative lead. To avoid damage to the meter, always connect the negative lead to the negative (-) side of the circuit (to ground or nearest the ground side of the circuit) and connect the positive lead to the positive (+) side of the circuit (to the power source or the nearest power source). Note that the negative voltmeter lead will always be black and that the positive voltmeter will always be some color other than black (usually red).
- Ohmmeter—the ohmmeter is designed to read resistance (measured in ohms) in a circuit or component. Most ohmmeters will have a selector switch which permits the measurement of different ranges of resistance (usually the selector switch allows the multiplication of the meter reading by 10, 100, 1,000 and 10,000). Some ohmmeters are "auto-ranging" which means the meter itself will determine which scale to use. Since the meters are powered by an internal battery, the ohmmeter can be used like a self-powered test light. When the ohmmeter is connected, current from the ohmmeter flows through the circuit or component being tested. Since the ohmmeter's internal resistance and voltage are known values, the amount of current flow through the meter depends on the resistance of the circuit or component being tested. The ohmmeter can also be used to perform a continuity test for suspected open circuits. In using the meter for making continuity checks, do not be concerned with the actual resistance readings. Zero resistance, or any ohm reading, indicates continuity in the circuit. Infinite resistance indicates an opening in the circuit. A high resistance reading where there should be none indicates a problem in the circuit. Checks for short circuits are made in the same manner as checks for open circuits, except that the circuit must be isolated from both power and normal ground. Infinite resistance indicates no continuity, while zero resistance indicates a dead short.

***** WARNING**

Never use an ohmmeter to check the resistance of a component or wire while there is voltage applied to the circuit.

- Ammeter—an ammeter measures the amount of current flowing through a circuit in units called amperes or amps. At normal operating voltage, most circuits have a characteristic amount of amperes, called "current draw" which can be measured using an ammeter. By referring to a specified current draw rating, then measuring the amperes and comparing the two values, one can determine what is happening within the circuit to aid in diagnosis. An open circuit, for example, will not allow any current to flow, so the ammeter reading will be zero. A damaged component or circuit will have an increased current draw, so the reading will be high. The ammeter is always connected in series with the circuit being tested. All of the current that normally flows through the circuit must also flow through the ammeter; if there is any other path for the current to follow, the ammeter reading will not be accurate. The ammeter itself has very little resistance to current flow and, therefore, will not affect the circuit, but it will measure current draw only when the circuit is closed and electricity is flowing. Excessive current draw can blow fuses and drain the battery, while a reduced current draw can cause motors to run slowly, lights to dim and other components to not operate properly.

Troubleshooting Electrical Systems

When diagnosing a specific problem, organized troubleshooting is a must. The complexity of a modern automotive vehicle demands that you approach any problem in a logical, organized manner. There are certain troubleshooting techniques, however, which are standard:

- Establish when the problem occurs. Does the problem appear only under certain conditions? Were there any noises, odors or other unusual symptoms? Isolate the problem area. To do this, make some simple tests and observations, then eliminate the systems that are working properly. Check for obvious problems, such as broken wires and loose or dirty connections. Always check the obvious before assuming something complicated is the cause.
- Test for problems systematically to determine the cause once the problem area is isolated. Are all the components functioning properly? Is there power going to electrical switches and motors. Performing careful, systematic checks will often turn up most causes on the first inspection, without wasting time checking components that have little or no relationship to the problem.
- Test all repairs after the work is done to make sure that the problem is fixed. Some causes can be traced to more than one component, so a careful verification of repair work is important in order to pick up additional malfunctions that may cause a problem to reappear or a different problem to arise. A blown fuse, for example, is a simple problem that may require more than another fuse to repair. If you don't look for a problem that caused a fuse to blow, a shorted wire (for example) may go undetected.

Experience has shown that most problems tend to be the result of a fairly simple and obvious cause, such as loose or corroded connectors, bad grounds or damaged wire insulation which causes a short. This makes careful visual inspection of components during testing essential to quick and accurate troubleshooting.

Testing

OPEN CIRCUITS

➧ See Figure 8

This test already assumes the existence of an open in the circuit and it is used to help locate the open portion.

1. Isolate the circuit from power and ground.
2. Connect the self-powered test light or ohmmeter ground clip to the ground side of the circuit and probe sections of the circuit sequentially.
3. If the light is out or there is infinite resistance, the open is between the probe and the circuit ground.
4. If the light is on or the meter shows continuity, the open is between the probe and the end of the circuit toward the power source.

TCCA6P10

Fig. 8 The infinite reading on this multimeter indicates that the circuit is open

SHORT CIRCUITS

➡Never use a self-powered test light to perform checks for opens or shorts when power is applied to the circuit under test. The test light can be damaged by outside power.

1. Isolate the circuit from power and ground.

2. Connect the self-powered test light or ohmmeter ground clip to a good ground and probe any easy-to-reach point in the circuit.
3. If the light comes on or there is continuity, there is a short somewhere in the circuit.
4. To isolate the short, probe a test point at either end of the isolated circuit (the light should be on or the meter should indicate continuity).
5. Leave the test light probe engaged and sequentially open connectors or switches, remove parts, etc. until the light goes out or continuity is broken.
6. When the light goes out, the short is between the last two circuit components which were opened.

VOLTAGE

This test determines voltage available from the battery and should be the first step in any electrical troubleshooting procedure after visual inspection. Many electrical problems, especially on computer controlled systems, can be caused by a low state of charge in the battery. Excessive corrosion at the battery cable terminals can cause poor contact that will prevent proper charging and full battery current flow.

1. Set the voltmeter selector switch to the 20V position.
2. Connect the multimeter negative lead to the battery's negative (-) post or terminal and the positive lead to the battery's positive (+) post or terminal.
3. Turn the ignition switch **ON** to provide a load.
4. A well charged battery should register over 12 volts. If the meter reads below 11.5 volts, the battery power may be insufficient to operate the electrical system properly.

VOLTAGE DROP

➧ See Figure 9

When current flows through a load, the voltage beyond the load drops. This voltage drop is due to the resistance created by the load and also by small resistances created by corrosion at the connectors and damaged insulation on the wires. The maximum allowable voltage drop under load is critical, especially if there is more than one load in the circuit, since all voltage drops are cumulative.

1. Set the voltmeter selector switch to the 20 volt position.
2. Connect the multimeter negative lead to a good ground.
3. Operate the circuit and check the voltage prior to the first component (load).
4. There should be little or no voltage drop in the circuit prior to the first component. If a voltage drop exists, the wire or connectors in the circuit are suspect.
5. While operating the first component in the circuit, probe the ground side of the component with the positive meter lead and observe the voltage readings. A small voltage drop should be noticed. This voltage drop is caused by the resistance of the component.
6. Repeat the test for each component (load) down the circuit.
7. If a large voltage drop is noticed, the preceding component, wire or connector is suspect.

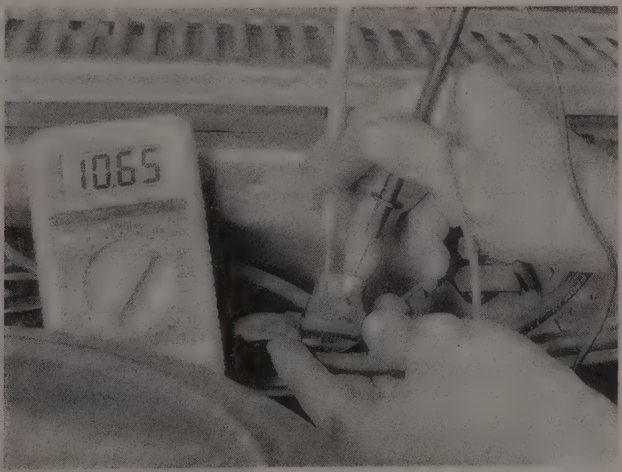


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Fig. 9 This voltage drop test revealed high resistance (low voltage) in the circuit

RESISTANCE

➧ See Figures 10 and 11

✻✻ WARNING

Never use an ohmmeter with power applied to the circuit. The ohmmeter is designed to operate on its own power supply. The normal 12 volt electrical system voltage could damage the meter!

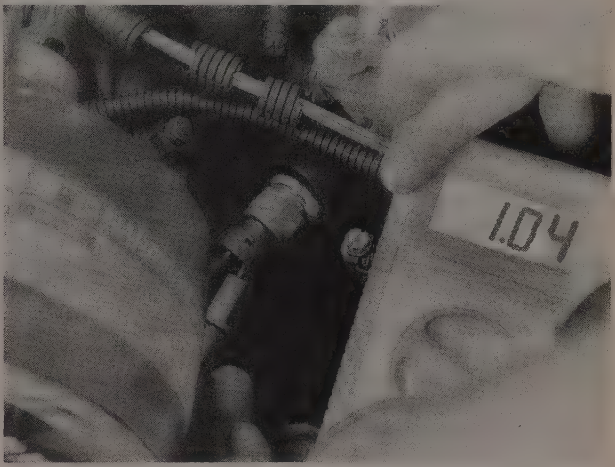

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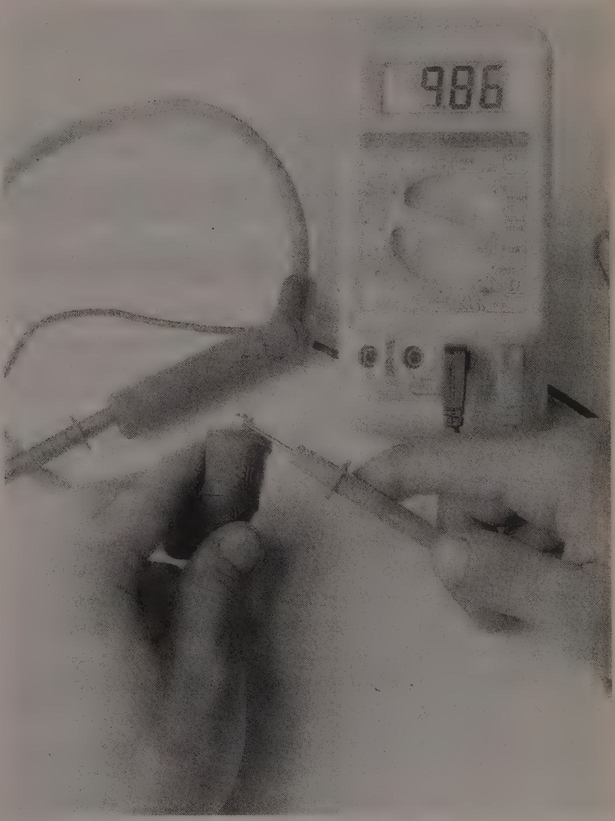
Fig. 10 Checking the resistance of a coolant temperature sensor with an ohmmeter. Reading is 1.04 kilohms



TCCA6P09

Fig. 11 Spark plug wires can be checked for excessive resistance using an ohmmeter

1. Isolate the circuit from the vehicle's power source.
2. Ensure that the ignition key is **OFF** when disconnecting any components or the battery.
3. Where necessary, also isolate at least one side of the circuit to be checked, in order to avoid reading parallel resistances. Parallel circuit resistances will always give a lower reading than the actual resistance of either of the branches.
4. Connect the meter leads to both sides of the circuit (wire or component) and read the actual measured ohms on the meter scale. Make sure the selector switch is set to the proper ohm scale for the circuit being tested, to avoid misreading the ohmmeter test value.

Wire and Connector Repair

Almost anyone can replace damaged wires, as long as the proper tools and parts are available. Wire and terminals are available to fit almost any need. Even the specialized weatherproof, molded and hard shell connectors are now available from aftermarket suppliers.

Be sure the ends of all the wires are fitted with the proper terminal hardware and connectors. Wrapping a wire around a stud is never a permanent solution and will only cause trouble later. Replace wires one at a time to avoid confusion. Always route wires exactly the same as the factory.

➡If connector repair is necessary, only attempt it if you have the proper tools. Weatherproof and hard shell connectors require special tools to release the pins inside the connector. Attempting to repair these connectors with conventional hand tools will damage them.

BATTERY CABLES

Disconnecting the Cables

✻✻ WARNING

Make sure the battery cables are connected to the correct battery terminals. Reverse polarity may damage electrical components, particularly the (expensive) engine controller.

Before performing work on the vehicle, it is usually required to disconnect the battery from the electrical system. Whether this is to prevent a mistaken start-up or electrical power from being supplied to the system components, the certain measure is to shut off the power at the source.

To disconnect the battery cable(s), perform the following:

1. Make sure the ignition switch is **OFF**.

➡Disconnecting the negative battery cable FIRST with the ignition turned OFFis required to prevent unwanted surges through the electrical system. If a voltage spike is fed through the system, delicate and expensive componentry (like the engine controller) could be destroyed in fractions of a second.

2. Use the appropriate size wrench(es) to loosen the hardware on the cable clamps. ALWAYS begin with the negative battery cable.

✻✻ WARNING

Diesel engine models have two 12 volt batteries connected in parallel (positive-positive/negative-negative). The secondary on the passenger's side is dedicated to providing current to the intake manifold air heater. The primary battery on the driver's side is dedicated to all other vehicle electrical requirements. In order to ensure accurate diagnostic results, these batteries must be disconnected from each other and from the vehicle electrical system when being tested.

3. If necessary, use a puller tool designed for battery cable clamps and remove the clamp, then isolate it from the battery terminal.
4. Remove the positive battery cable, if required, once the negative battery cable has been removed.

SUPPLEMENTAL RESTRAINT SYSTEM (AIR BAG)

General Information

✻✻ CAUTION

This system is a sensitive, complex electro-mechanical unit. Before attempting to diagnose or service, you must first disconnect the negative battery cable and wait 2 minutes for the system capacitor to discharge. Failure to do so could result in accidental deployment which could cause personal injury.

SYSTEM OPERATION

The SRS (air bag) is a safety device designed to be used in conjunction with the seatbelt. Its purpose is to help protect the driver in a frontal impact exceeding a certain set limit. The system consists of the air bag module, three impact sensors, a clockspring and a dedicated air bag control module.

The air bag is a fabric bag or balloon with an explosive inflator unit attached. The system employs impact sensors and a safing sensor as well as an inflator circuit and control module.

When the control unit receives the sensor signals, power is supplied to the inflator circuit, either from the battery or back-up system. A small heater causes a chemical reaction in the igniter; the non-toxic gas from the chemical mixture expands very rapidly (in milliseconds), filling the bag and forcing it through the cover pad. Since all this is happening very rapidly, the expanding bag should reach the occupant before he/she reaches the steering wheel/dashboard during a frontal collision. The chemical reaction is complete by the time the air bag is fully inflated; as the occupant hits the bag, the gas is allowed to escape slowly through vents in the back of the bag.

SYSTEM COMPONENTS

Air Bag Module

The air bag module is mounted directly to the steering wheel beneath a protective cover. Under the air bag module protective cover, the air bag cushion and its supporting components are contained. The air bag module contains a housing to which the cushion and inflator are attached and sealed. The air bag module is non-repairable. If it is dropped or damaged, it must be replaced.

The inflator assembly is mounted to the back of the module. The inflator seals the hole in the air bag cushion so it can discharge the gas it produces directly into the cushion when supplied with the proper electrical signal. Upon deployment, the protective cover will split horizontally.

Impact Sensors

The three impact sensors used in the SRS system verify the direction and severity of an impact. One of the sensors is called the safing sensor. It is located in the Air Bag Control Module (ACM), which is mounted to a bracket under the instrument panel, on top of the floor pan transmission tunnel. The other two sensors impact sensors and are mounted on the left and right inner fender extension panels behind the grille. The sensors are calibrated for the particular vehicle that they serve.

The impact sensors are threshold sensitive switches that complete an electrical circuit when an impact provides a sufficient deceleration force to close the switch. The safing sensor is an accelerometer that senses the rate of deceleration. The microprocessor in the ACM monitors the sensor signals. A pre-programmed decision algorithm in the microprocessor determines when the deceleration rate indicates an impact that is severe enough to require air bag system protection.

The two impact sensors are available for service replacement. The safing sensor is only serviced as part of the ACM.

Clockspring

The clockspring is mounted on the steering column behind the steering wheel. Its purpose is to maintain a continuous electrical circuit between the wiring harness and the driver's side air bag module. This assembly consists of a flat, ribbon-like electrically conductive tape that wings and unwinds with the steering wheel rotation.

Air Bag Control Module (ACM)

The ACM contains the safing sensor, and a microprocessor that monitors the air bag system to determine readiness. It also monitors the impact sensors to determine when the proper conditions exist to provide the electrical signal that deploys the air bag. The ACM contains On-Board Diagnostics (OBD), and will light the air bag warning lamp on the instrument panel is a (monitored) air bag system fault occurs. If the light does not come on, does not go out or comes on when driving, the system must be diagnosed and repaired by a Dodge dealer or reputable shop. The system is NOT repairable at home.

The ACM also contains an energy-storage capacitor. The capacitor stores enough electrical energy to deploy the air bag for up to two minutes following a battery disconnect or failure. The purpose of the capacitor is to provide air bag system protection in a severe secondary impact if the initial impact somehow damaged or disconnected the battery, but did not deploy the air bag.

SERVICE PRECAUTIONS

This manual does not cover SRS repairs or replacement as such work should be left to a trained professional. The following precautions then, are only to inform the do-it-yourselfer and give him a greater appreciation for the system when required to work in proximity to SRS components.

- Replace air bag system components only with parts specified in the Chrysler Mopar parts catalog. Substitute parts may appear interchangeable, but internal differences may result in inferior occupant protection.
- The fasteners, screws and bolts have special coatings and are specially designed for the air bag SRS system. Never replace them with substitutes. Always use the correct replacement fasteners as supplied by the Chrysler Mopar parts catalog.
- No SRS component should be used if it shows any sign of being dropped, dented or otherwise damaged.
- SRS components formerly installed in another vehicle should never be used. Only new components should be installed.
- Whenever working on SRS components (except for electrical inspections), always disconnect both the positive and negative battery terminals and then wait at least two minutes before beginning (and taking other precautions as necessary).
- Whenever the air bag has been activated, replace the SRS unit.
- Whenever the ignition switch is **ON** or has been turned **OFF** for less than two minutes, be careful not to bump the SRS unit; the air bags could accidentally deploy and do damage or cause injuries.
- Do not try to take apart the air bag assembly. Once deployed, it cannot be re-used or repaired.
- For temporary storage of the air bag assembly while servicing the vehicle, place it with the pad surface UP. Store the air bag assembly on a secure, clean, flat surface away from heat, oil, grease, water or detergent.

***** CAUTION**

If the air bag is stored face down, it could spontaneously deploy and cause serious injury and damage.

- Take extra care when doing paint or body work near the air bag assembly and keep away heat guns, welding and spray equipment from the air bag assembly.
- Make sure SRS wiring harnesses are not pinched, and all ground contacts are clean. Poor grounding can cause intermittent problems that are difficult to diagnose.

DISARMING THE SYSTEM

1. First read the system precautions.
2. Disconnect and isolate the negative battery cable.
3. If the air bag module is undeployed, wait two minutes for the system capacitor to discharge.

ARMING THE SYSTEM

Assuming the system components (air bag control module, sensors, air bag, etc.) are installed correctly and are in good working order, the system is armed whenever the battery positive and negative battery cables are connected.

If you have disarmed the air bag system for any reason, to re-arm, make sure no one is in the vehicle (as an added safety measure), then connect the battery negative cable.

CLOCKSPRING CENTERING

If the rotating tape within the clockspring is not positioned properly in relation to the steering wheel and the front wheels, the clockspring may fail during use. The clockspring MUST BE CENTERED.

1. Place the front wheels in the straight-ahead position.
2. Disconnect the negative battery cable and wait at least two full minutes.
3. Remove the air bag module. Remove the steering wheel with a suitable puller tool.
4. Unlock the two plastic auto-locking tabs.
5. Keep the locking mechanism disengaged while rotating the clockspring rotor CLOCKWISE to the end of its travel. Do not apply excessive torque.
6. From the end of travel, rotate the rotor 2 ½ turns COUNTER CLOCKWISE. The horn wire should end up at the top, and the air bag wire at the bottom.
7. Install the steering wheel and the air bag module.
8. Perform an air bag system check BEFORE connecting the negative battery cable.

HANDLING A LIVE MODULE

At no time should any source of electricity be permitted near the inflator on the back of the module. When carrying a live module (such as when removing the steering wheel), the trim cover should be pointed away from the body to minimize injury in the event of accidental deployment. In addition, if the module is placed on a bench or other surface, the plastic trim cover should be face up to minimize movement in case of accidental deployment.

When handling a steering column with an air bag module attached, never place the column of the floor or other surface with the steering wheel or module face down.

DEPLOYED MODULE

The vehicle interior may contain a very small amount of sodium hydroxide powder, a by-product of air bag deployment. Since this powder can irritate the skin, eyes, nose or throat, be sure to wear safety glasses, rubber gloves and long sleeves during cleanup.

If you find that the cleanup is irritating your skin, run cool water over the affected area. Also, if you experience nasal or throat irritation, exit the vehicle for fresh air until the irritation ceases. If irritation continues, see a physician.

Clean-Up Procedure

▶ See Figure 12

Begin the clean-up by putting tape over the two air bag exhaust vents so that no additional powder will find its way into the vehicle interior. Then remove the air bag and air bag module from the vehicle.

Use a vacuum cleaner to remove any residual powder from the vehicle interior. Work from the outside in so that you avoid kneeling or sitting in a uncleaned area.

Be sure to vacuum the heater and A/C outlets as well. In fact it's a good idea to run the blower on low and to vacuum up any powder expelled from the plenum. You may need to vacuum the interior of the vehicle a second time to recover all of the powder.

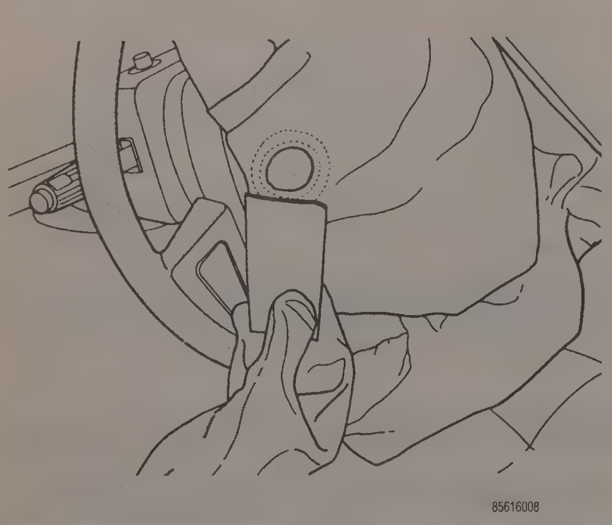

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Fig. 12 Seal the air bag exhaust vents

Servicing a Deployed Air Bag

After an air bag has been deployed, the air bag module and clockspring must be replaced because they cannot be reused. Other air bag system components must also be replaced if damaged.

AIR BAG SYSTEM CHECK

WARNING

Disconnect and isolate the battery negative cable before beginning any air bag system component removal or installation procedure. This will disable the air bag system. Failure to disconnect the battery could result in accidental air bag deployment and possible personal injury. Allow system capacitor to discharge for 2 minutes before removing any air bag components.

1. Disconnect the battery negative cable and isolate.
2. Remove forward console or cover as necessary.
3. Connect DRB to ACM data link 6-way connector, located at right of steering column.
4. Turn the ignition key to **ON** position. Exit vehicle with DRB. Use the latest version of the proper cartridge.
5. After checking that no one is inside the vehicle, connect the battery negative cable.
6. Using the DRB, read and record active diagnostic data.
7. Read and record any stored diagnostic codes.
8. Correct any problems found in Steps 6 and 7.
9. Erase stored diagnostic codes if there are no active diagnostic codes. If problems remain, diagnostic codes will not erase.
10. Turn the ignition key to **OFF** then **ON** and observe the message center air bag lamp. It should go on for six to eight seconds, then go out; indicating system is functioning normally.
11. If air bag warning lamp either fails to light, blinks on and off or goes on and stays on, there is a system malfunction.

HEATER

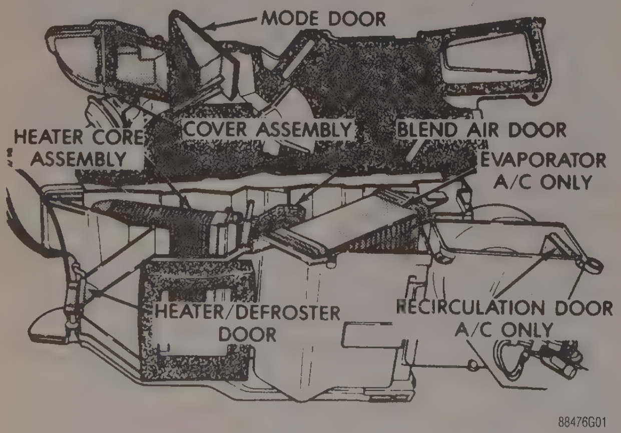
Blower Motor

REMOVAL & INSTALLATION

Dakota

➧ See Figure 13

1. Disconnect the negative battery cable.
2. Remove the steering column cover, intermittent wiper control and the lower instrument panel module retaining screw to the right of the steering column.
3. Remove the center distribution duct retaining screws and panel support screw at the bottom of the module.
4. Remove the courtesy lamp at the lower right corner of the module and the screw near the ash receiver.
5. Open the glovebox and remove the screws along the top edge.
6. Move the module out and down far enough to unclip the wiring harness and antenna cable and disconnect the speaker wire (if equipped with monaural radio) and glovebox light wire. Remove the module from the vehicle.
7. If the vehicle is equipped with air conditioning, disconnect the two vacuum lines from the recirculating air door actuator and disconnect the blower lead wires.
8. Remove two screws at the top of the blower housing, five screws from around the housing and remove the blower housing from the unit.
9. Remove three screw attaching the blower to the unit and remove the blower from the vehicle.
10. Remove the fan from the blower motor.
11. Installation is the reverse of removal. Secure all components accordingly and check the blower motor for proper operation.



88476G01

Fig. 13 Heating/air conditioning unit components—Dakota models

Pick-Up and Ramcharger

➧ See Figures 14 thru 19

1. Disconnect the negative battery cable.
2. Disconnect the blower wiring.
3. Remove the blower motor cooling tube.
4. Remove the screws or retaining nuts retaining the blower plate to the housing.
5. Remove the assembly from the housing.
6. Remove the spring clip fastening the blower wheel to the blower shaft and pull off the wheel. Remove the blower from the plate.
7. Installation is the reverse of removal.

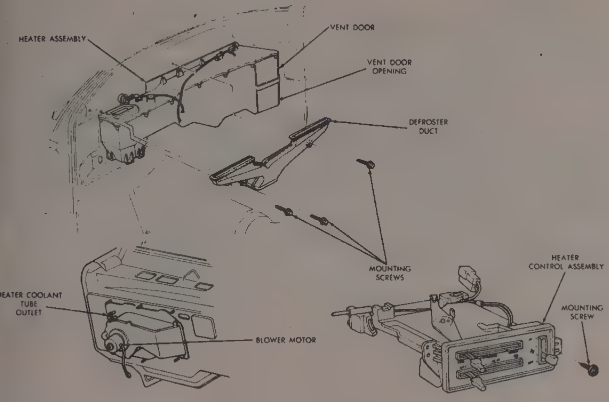
Heater Core

REMOVAL & INSTALLATION

Dakota

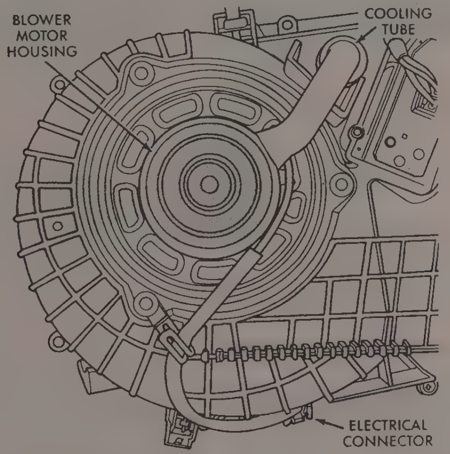
WITHOUT AIR CONDITIONING

1. Disconnect the negative battery cable. Drain the coolant.


HEATER ASSEMBLY
VENT DOOR
VENT DOOR OPENING
DEFROSTER DUCT
MOUNTING SCREWS
HEATER CONTROL ASSEMBLY
HEATER COOLANT TUBE OUTLET
MOUNTING SCREW
BLOWER MOTOR

88476G00

Fig. 14 Exploded view of the heater assembly components for Pick-up and Ramcharger models


BLOWER MOTOR HOUSING
COOLING TUBE
ELECTRICAL CONNECTOR

88476G06

Fig. 15 Disconnect the wiring and cooling tube to access the blower motor—1994–96 models shown

88476P14

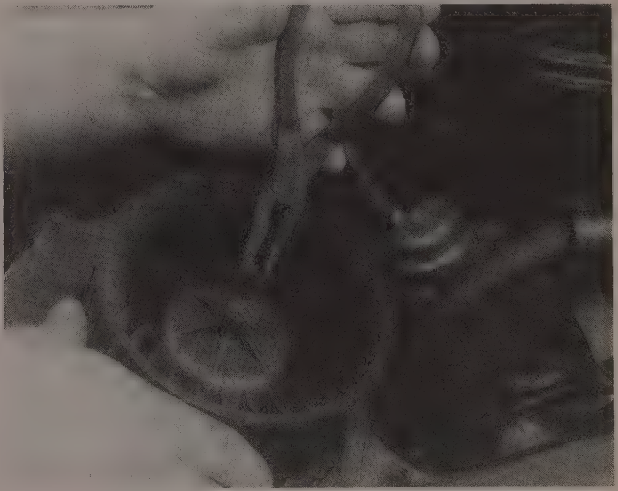
Fig. 16 Unplug the wiring harness connector to the blower motor

88476P15

Fig. 17 Unfasten the blower plate housing screws

88476P16

Fig. 18 Lift away the blower plate housing for access to the blower motor



88476P17

Fig. 19 Unclip and remove the blower wheel

2. Remove the steering column cover, intermittent wiper control, if equipped and the lower instrument panel module retaining screw to the right of the steering column.
3. Remove the center distribution duct retaining screws and panel support screw at the bottom of the module.
4. Remove the courtesy lamp at the lower right corner of the module and the screw near the ash receiver.
5. Open the glovebox and remove the screws along the top edge.
6. Move the module out and down far enough to unclip the wiring harness and antenna cable and disconnect the speaker wire (if equipped with monaural radio) and glovebox light wire. Remove the module from the vehicle.
7. Remove the center air distribution duct.
8. Remove the antenna wire from retaining clip at the right end of the heater unit.
9. Disconnect the blower motor connector and remove the thermal insulator retainer from the heater unit.
10. Disconnect the demister hoses from the adaptor at the top of the heater unit.
11. Disconnect the vacuum feed line from the check valve.
12. Disconnect the temperature control cable flag retainer from the heater unit.
13. Remove the adjusting clip from the blend air door crank.
14. Disconnect the heater hoses from the core tubes and plug them.
15. Remove the four heater unit attaching nuts from the rear engine compartment dash panel.
16. Remove the heater unit support attaching screw and rotate the brace out of the way.
17. Remove the heater unit from the vehicle.
18. To disassemble the housing assembly, vacuum diaphragm and retaining screws from the cover and remove the cover.
19. Remove the retaining screw from the heater core and remove the core from the housing assembly.
20. Installation is the reverse of removal.

WITH AIR CONDITIONING

1. Disconnect the negative battery cable. Properly discharge the air conditioning system. Drain the coolant.
2. Remove the steering column cover, intermittent wiper control and the lower instrument panel module retaining screw to the right of the steering column.
3. Remove the center distribution duct retaining screws and panel support screw at the bottom of the module.
4. Remove the courtesy lamp at the lower right corner of the module and the screw near the ash receiver.
5. Open the glovebox and remove the screws along the top edge.
6. Move the module out and down far enough to unclip the wiring harness and antenna cable and disconnect the speaker wire (if equipped with monaural radio) and glovebox light wire. Remove the module from the vehicle.
7. Remove the center air distribution duct.
8. Remove the antenna wire from retaining clip at the right end of the heater unit.
9. Disconnect the blower motor connector and remove the thermal insulator retainer from the heater unit.
10. Disconnect the demister hoses from the adaptor at the top of the heater unit.
11. Disconnect the vacuum harness connector from the air conditioning control hose and vacuum feed line from the check valve.
12. Disconnect the temperature control cable flag retainer from the heater unit and remove the adjusting clip from the blend air door crank.
13. Disconnect the heater hoses from the core tubes and plug them.
14. Remove the condensation drain tube.
15. Remove the 4 heater/air conditioning unit attaching nuts from the rear engine compartment dash panel.
16. Remove the heater/air conditioning unit support attaching screw and rotate the brace out of the way.
17. Remove the heater/air conditioning unit from the vehicle.
18. To disassemble the housing assembly, vacuum diaphragm and retaining screws from the cover and remove the cover.
19. Remove the retaining screw from the heater core and remove the core from the housing assembly.
20. Installation is the reverse of removal. Connect the negative battery cable and check the entire climate control system for proper operation and leakage.

1989–93 Pick-Up and Ramcharger

➧ See Figure 20

WITHOUT AIR CONDITIONING

1. Disconnect the negative battery cable.
2. Drain the cooling system. Remove and plug the heater core hoses.
3. Remove the right side cowl trim panel, if equipped. Remove the glove box assembly. Remove the structural brace through the glovebox opening.
4. Remove the right half of the instrument panel lower reinforcement and disconnect the ground strap.
5. Disconnect the control cables from the heater housing and the blower motor wires on the engine side.

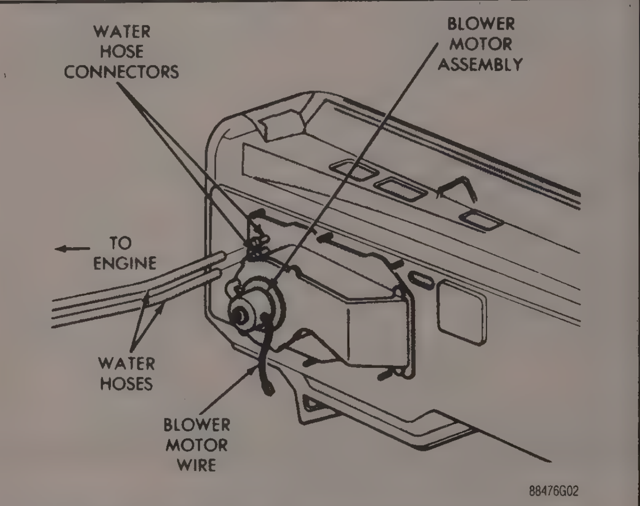


Fig. 20 Disconnect the heater (water) hoses when removing the heater core

6. Remove the retaining screw between the package to cowl side sheet metal.
7. Remove the heater housing retaining nuts on the engine side of the heater assembly and remove the heater housing assembly.
8. Remove the heater housing cover retaining screws and the mode door crank. Separate the cover from the housing.
9. Carefully lift the heater core from the heater housing.
10. Installation is the reverse of removal. Refill the radiator.
11. Connect the negative battery cable, run the vehicle until the thermostat opens, fill the radiator completely and check the operation of the heater.
12. Once the vehicle has cooled, recheck the coolant level.

WITH AIR CONDITIONING

1. Disconnect the negative battery cable. Properly discharge the air condition system. Drain the cooling system. Disconnect and plug the heater hoses and the refrigerant lines.
2. Remove the condensation tube from the housing.
3. Move the transfer case and gear shift levers away from the instrument panel, if equipped.
4. Remove the right side cowl trim panel, if equipped. Remove the glove box and swing it out from the bottom.
5. Remove the structural brace from the through hole in the glove box opening. Remove the ash receiver.
6. Remove the right lower half of the dash reinforcement by removing the retaining screws holding it to the instrument panel and to the cowl side trim panel.
7. Disconnect the radio ground strap, if equipped. Remove the center and floor air distribution ducts.
8. Disconnect the temperature control cable from the assembly and tape it out of the way.
9. Disconnect the vacuum lines from the extension on the control unit and unclip the vacuum lines from the defroster duct.

10. Remove the wiring connector from the resistor block. Remove the blower motor electrical connector from the engine side of the assembly.
11. Disconnect the vacuum lines on the engine side and make sure the grommet is free from the dash panel.
12. Remove the retaining nuts on the engine side. Remove the screw that retains the assembly to the cowl side of the sheet metal.
13. Remove the assembly from the vehicle.
14. Remove the vacuum actuators, door crank levers, evaporator case cover retaining nuts and screws and the heater core retaining screws. Lift the cover off of the assembly and remove the heater core from its mounting.
15. Installation is the reverse of removal. Tighten all components securely.
16. Evacuate and recharge the air conditioning system. Refill the radiator.
17. Connect the negative battery cable, run the vehicle until the thermostat opens, fill the radiator completely and check the operation of the entire climate control system.
18. Once the vehicle has cooled, recheck the coolant level.

1994–96 Pick-Ups

1. Remove the heater/air conditioning housing (as described in this section).
2. Remove the heater core retaining screws.
3. Pull the heater core straight out of the housing.
4. Installation is the reverse of removal.

Heater Water Control Valve

REMOVAL & INSTALLATION

1. Drain the cooling system so that the level (of the system) is below the control valve.
2. Loosen the heater hose clamps and remove the hoses.
3. Disconnect the vacuum line to the valve vacuum control.
4. Remove the mounting screws and remove the valve.
5. Place the control in position and secure it. Connect the heater hoses (replace any hoses that show wear) and secure the hose clamps. Connect the vacuum line(s).
6. Fill the cooling system and check the control valve operation.

Heater/Air Conditioning Housing

REMOVAL & INSTALLATION

1994–96 Pick-Ups

➧ See Figures 21, 22 and 23

1. Disconnect the negative battery cable.
2. Take the vehicle to a certified refrigerant recovery/recycling station and have the air conditioning system refrigerant properly recovered.
3. Disconnect the refrigerant lines from the evaporator tubes. Install plugs or tape over all the open refrigerant lines.
4. Drain the cooling system.
5. Disconnect the heater hoses from the heater core tubes.
6. Remove the coolant reserve/overflow bottle.
7. Remove the Powertrain Control Module (PCM) and set it aside. Do NOT disconnect the PCM connectors.
8. Remove the heater/air conditioning housing mounting nuts from the studs on the engine compartment side of the dash panel.
9. Remove the instrument panel.
10. Remove the defroster duct.
11. Unplug the electrical connections.
12. Remove the housing mounting nuts from the studs on the passenger compartment side of the dash panel.
13. Remove the heater/air conditioning housing from the vehicle.
14. Installation is the reverse of removal. Secure mounting nuts to the studs on the engine compartment side of the dash panel to 60 inch lbs. (7 Nm).
15. Fill the cooling system. Have the refrigerant system properly evacuated and charged.
16. Connect the negative battery cable.

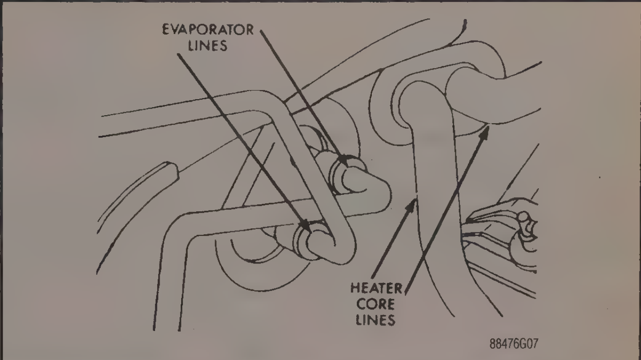


Fig. 21 Disconnect the evaporator and heater core lines—1994–96 models

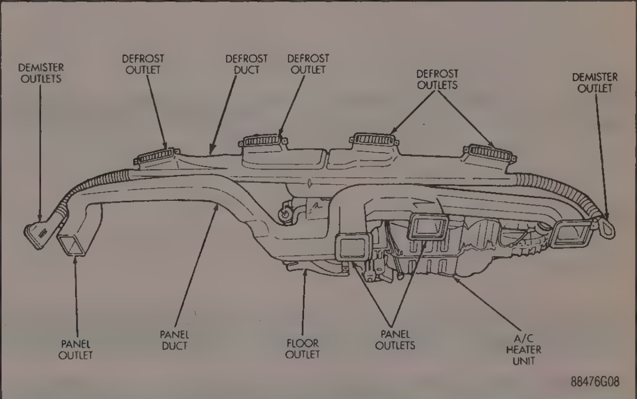


Fig. 22 Remove the defroster duct assembly to access the heater/air conditioning housing

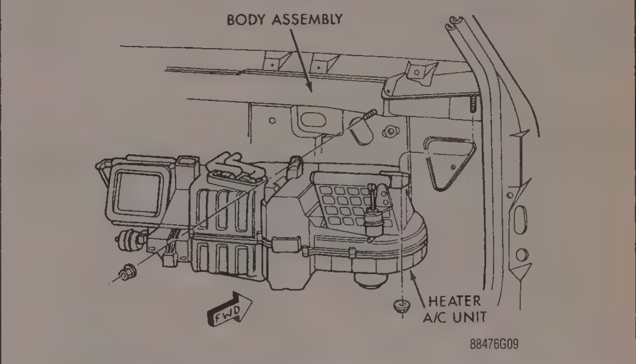


Fig. 23 Exploded view of the heater/air conditioning housing mounting

Control Head

REMOVAL & INSTALLATION

➧ See Figures 24, 25 and 26

1. Remove the face plate.
2. Remove the control attaching screws.
3. Pull the control rearward.
4. On models with air conditioning, perform the following:
   a. Disconnect the blower switch wiring.
   b. Disconnect the push-button switch wiring.
5. Disconnect the panel light.
6. On models with air conditioning, disconnect the vacuum harness.

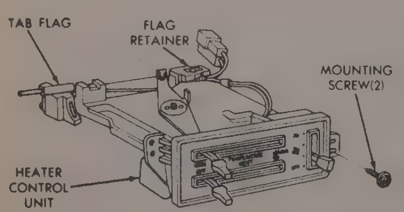


Fig. 24 Details of a common manual A/C control head

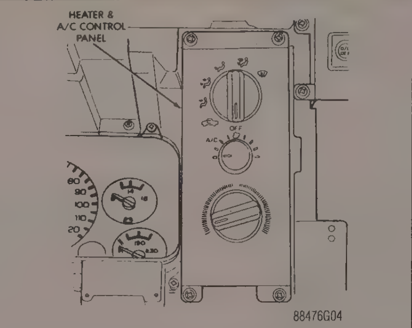


Fig. 25 Remove the bezel, then the screws to access the heater/air conditioning control head—1994–96 models shown

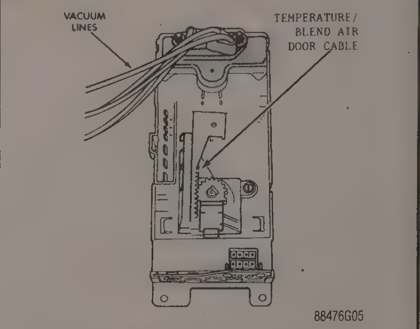


Fig. 26 Disconnect the vacuum lines from the rear of the control head—1994–96 models shown

7. Disconnect the control cable(s).
8. Remove the unit.
9. Installation is the reverse of removal. Adjust the cables.

Air Conditioning Components

REMOVAL & INSTALLATION

Repair or service of air conditioning components is not covered by this manual, because of the risk of personal injury or death, and because of the legal ramifications of servicing these components without the proper EPA certification and experience. Cost, personal injury or death, environmental damage, and legal considerations (such as the fact that it is a federal crime to vent refrigerant into the atmosphere), dictate that the A/C components on your vehicle should be serviced only by a Motor Vehicle Air Conditioning (MVAC) trained, and EPA certified automotive technician.

➡If your vehicle's A/C system uses R-12 refrigerant and is in need of recharging, the A/C system can be converted over to R-134a refrigerant (less environmentally harmful and expensive). Refer to Section 1 for additional information on R-12 to R-134a conversions, and for additional considerations dealing with your vehicle's A/C system.

CRUISE (SPEED) CONTROL

Control Switch

REMOVAL & INSTALLATION

Turn Signal Mounted

➧ See Figure 27

1. Disconnect the negative battery cable.
2. Remove the lower steering column cover.
3. Remove the wiring trough after unsnapping four plastic retaining clips.
4. Disconnect the speed control wiring from the instrument panel harness.
5. Remove the wiper control knob from the end of the turn signal lever.
6. Remove the silencer from the lever.
7. Remove the two screws attaching the switch to the column.
8. On tilt columns, remove the steering wheel.
9. On tilt columns, attach a flexible guide wire to the lower end of the speed control switch harness.

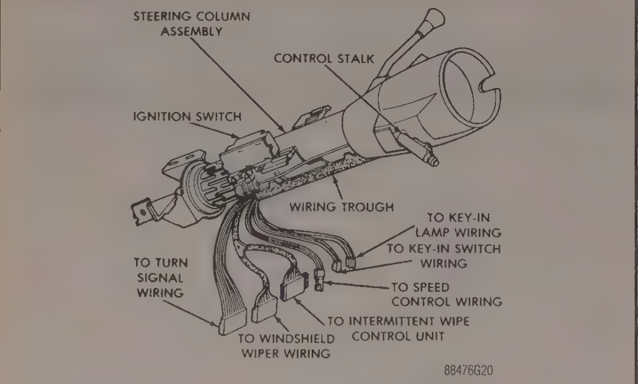


Fig. 27 Wiring harness connector identification

10. On standard columns, remove the upper steering column lock housing cover which is retained by two screws.
11. Gently remove the switch and harness from the column taking care to avoid damaging wires while pulling them up through the column.
12. On tilt columns pull the wires through the lock housing between the lockplate and side of housing. Them disconnect the guide wire from the harness.

To install:

13. On standard columns, insert the harness and connector through the turn signal lever opening in the column and pull down and out the lower end.
14. On tilt columns, insert the harness connector through the turn signal lever opening in the column and pull upward through the upper housing. Attach the guide wire to the switch wiring harness and gently pull downward through the column opening, between the lockplate and side of the housing. Take care not to damage the wires.
15. Remove all slack from the wires. On tilt columns, remove the guide wires. Install the wiring trough with the plastic clips.
16. Installation is the reverse of removal. Connect the negative battery cable and test the speed control operation.

Steering Wheel Mounted

1991–93 MODELS

1. Disconnect the negative battery cable.
2. From the under the steering wheel, remove the horn pad mounting screws.
3. Pull the pad up from the wheel and disconnect the electrical leads. Remove the pad.
4. Unplug the 4-way electrical connector from the clock spring.
5. Remove the four screws holding the switches and remove them.
6. Installation is the reverse of removal. Secure all components.

1994–96 MODELS

➧ See Figure 28

✱✱ CAUTION

Before working on any air bag system or related components, you must FIRST disconnect the negative battery cable and wait 2 min-

utes for the system capacitor to discharge. Failure to do so could cause accidental air bag deployment and personal injury could result.

1. Disconnect the negative battery cable.
2. Pull the switch module assembly from the wheel and unplug the electrical connector.
3. Installation is the reverse of removal. Secure the switch screws to 15 inch lbs. (1.5 Nm).

Vehicle Speed Sensor (VSS)

This sensor feeds information to the engine controller which operates and monitors the speed control system. The VSS is found on the extension housing on 2WD models or the transfer case on some 4WD models.

REMOVAL & INSTALLATION

➧ See Figures 29 and 30

1. Raise and safely support the vehicle.
2. Unplug the electrical connector.
3. On 1989–93 models, unscrew the speedometer cable (if equipped) from the sensor. Loosen the sensor nut and remove the sensor.
4. On 1994–96 models, remove the sensor mounting bolt, pull the sensor straight out of the speedometer pinion gear adapter. Do not remove the gear adapter from the transmission.

To install:

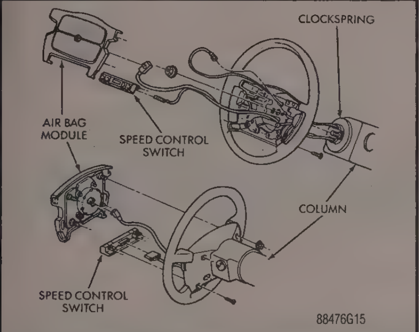


Fig. 28 Exploded view of the speed control switch mounting—1994–96 Pick-ups; Dakota is similar

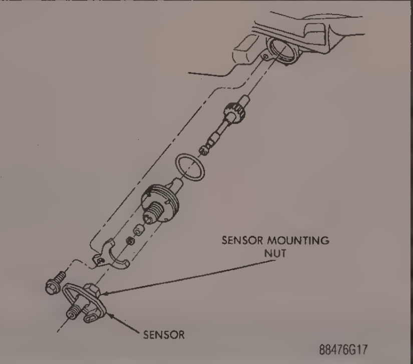


Fig. 29 Exploded view of the VSS mounting—1989–93 models

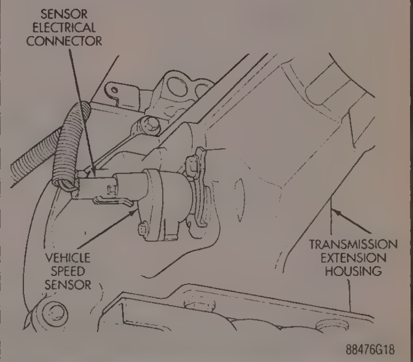


Fig. 30 Common location of the VSS—1994–96 models

➡On 1994–96 models, clean the inside of the pinion gear adapter. When mounted, make sure the sensor is fully seated before tightening the bolt.

5. All models: Install the sensor, tighten the nut, plug in the electrical connector and connect the speedometer cable, if equipped.

Servo

REMOVAL & INSTALLATION

➧ See Figure 31

Except 8.0L and 1994–96 Diesel Engines

1. Disconnect the vacuum hose at the servo.
2. Unplug the electrical connector at the servo.
3. Remove the two nuts from the servo mounting bracket.
4. Pull the speed control cable away from the servo to expose the retaining clip. Remove the clip.
5. Pull the servo away from the mounting bracket.

To install:

6. Block the throttle to full open (gas engines), pivot the bellcrank full rearward (diesel engine), and align the hole in the cable sleeve with the hole in the servo pin. Install the retaining clip.
7. Insert the servo studs through holes in the cable sleeve.
8. 1989–93 models: Install new push nuts on the servo studs, then insert the servo studs through the holes in the mounting bracket. Only one (1) stud mounts the reservoir.
9. Install the 2 attaching nuts and tighten to 50 inch lbs. (6 Nm).
10. Connect the vacuum hose to the servo.
11. Plug in the electrical connector.

8.0L and 1994–96 Diesel Engines

➧ See Figure 32

1. Disconnect both negative, then both positive battery cables.
2. Remove the battery hold-down, and if equipped, the battery heat shield(s).
3. Remove the battery from the vehicle.
4. Remove the battery tray mounting hardware, then lift the tray up far enough for access to the speed control servo electrical connector.
5. Unplug the electrical connector.
6. Pull the speed control cable away to expose the hairpin clip.
7. Remove the clip, then remove the servo.
8. Installation is the reverse of removal. Insert the servo studs through holes in the cable sleeve and tighten to 50 inch lbs. (6 Nm).

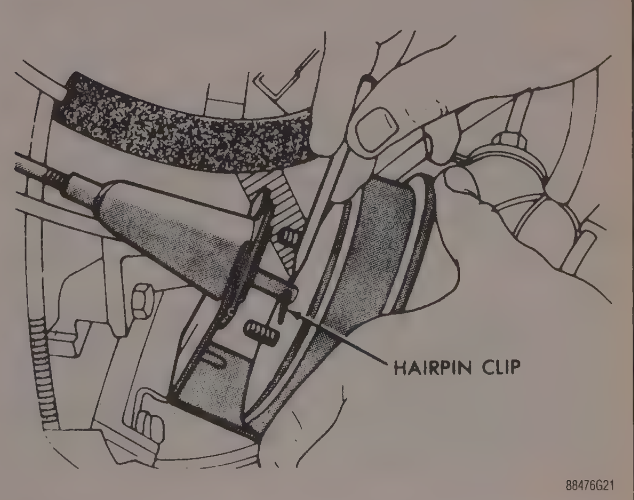


Fig. 31 Remove the hairpin retaining clip to detach the servo

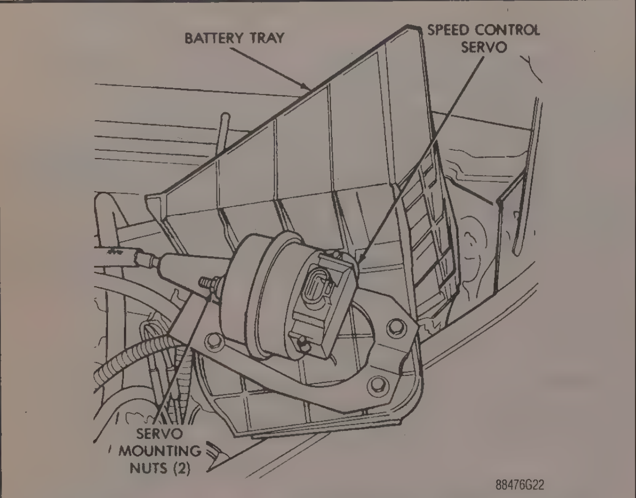


Fig. 32 Common speed control servo mounting position—8.0L and 1994–96 5.9L diesel engines

Servo Throttle Cable

REMOVAL & INSTALLATION

1989–93 Models

GASOLINE ENGINES

1. Remove the air cleaner.
2. Rotate the cable retaining cam up and slide to the throttle cable.
3. Slide out the speed control cable.
4. Remove the two nuts from the servo mounting bracket.
5. Pull the servo away from the mounting bracket.
6. Remove and discard the push nuts on the servo studs.
7. Pull the speed control cable away from the servo to expose the cable retaining clip.
8. Remove the clip attaching cable to the servo.
9. Disconnect the cable at the servo and remove the cable assembly.
10. Installation is the reverse of removal. Insert servo studs through holes in the bracket. Install nut washers and tighten to 50 inch lbs. (6 Nm).
11. Route the cable from the servo, through the support bracket. Install the cable on the throttle cam.

DIESEL ENGINES

1. Remove the hairpin clip and washer retaining cables on the bellcrank. Remove the servo cable from the bellcrank.
2. Remove the servo cable from the support bracket.
3. Remove the 2 nuts from the servo mounting bracket.
4. Pull the servo away from the mounting bracket.
5. Remove and discard the push nuts from the servo studs.
6. Pull the speed control cable away from the servo to expose the cable retaining clip.
7. Remove the clip attaching the cable to the servo.
8. Disconnect the cable at the servo, then remove the cable assembly.
9. Installation is the reverse of removal. Adjust the cable as described in this section under Speed Control Cable Adjustment.

1994–96 Models

1. Remove the air cleaner on all except the V10 and diesel engines.
2. Using finger pressure only, remove the speed control cable connector at the bellcrank by pushing the connector off the bellcrank. DO NOT try to pull the connector off perpendicular to the bellcrank.
3. Squeeze the tabs on the speed control cable and push out of the locking plate.
4. Remove the servo cable from the servo (as described in the servo removal/installation procedure).
5. To install, reverse the removal procedure.

ADJUSTMENT

➡This procedure pertains to 1989–93 diesel engines only.

1. The gap between the end of the slot on the cable and the bellcrank pin must be as small as possible (0–0.039 in./0–1mm) without moving the throttle. If the gap is not correct, remove the adjustment clip.
2. Push the protective sleeve into the housing to decrease the gap or pull the sleeve out of the housing to increase the gap.
3. Install the adjustment clip.

ENTERTAINMENT SYSTEMS

Radio

REMOVAL & INSTALLATION

1989–93 Pick-Ups and Ramchargers

➧ See Figures 33, 34 and 35

1. Disconnect the negative battery cable.
2. If applicable, remove the map light.
3. Remove the screws which attach the faceplate to the base panel. There is a screw below the heater-air conditioning control panel which is not visible from above.
4. If equipped with automatic transmission, place the shift lever in its lowest position.
5. Remove the faceplate by pulling the top edge rearward to clear the brow and pulling the bottom out, disengaging the attaching clips. If the vehicle is equipped with 4WD, disconnect the indicator wires.
6. Remove the screws that attach the radio to the dashboard.
7. Pull the radio out, disconnect the connectors, ground cable and antenna and remove the radio.
8. The installation is the reversal of the removal procedure.

1994–96 Pick-Ups

➧ See Figures 36 and 37

1. Disconnect the negative battery cable.
2. Unscrew and remove the ashtray bracket and cup holder.
3. Carefully pry the bezel away from the instrument panel to disengage the clips.
4. Unplug the cigar lighter.
5. Unplug the connector from the auxiliary power outlet.
6. Remove the two mounting screws from the front of the radio.
7. Pull the radio out far enough to unplug the wiring and antenna from the unit.
8. Remove the ground strap.
9. Installation is the reverse of removal.

Dakota

1. Disconnect the negative battery cable.
2. Remove the knee blocker/steering column cover and remove the instrument panel bezel. Two screws are hidden behind the steering column cover.
3. Remove the screws that attach the radio to the dashboard.
4. Pull the radio out, separate the connectors, ground cable and antenna, then remove the radio.
5. Installation is the reverse of the removal procedure.

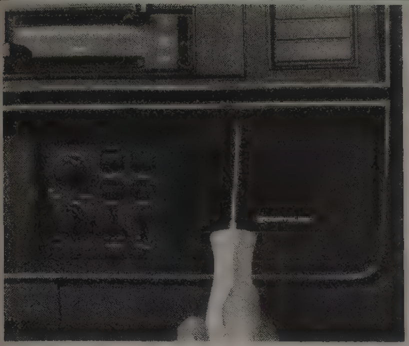

88476P11

Fig. 33 Remove the surrounding faceplate from the radio

88476P12

Fig. 34 Unscrew the radio mounting hardware . . .

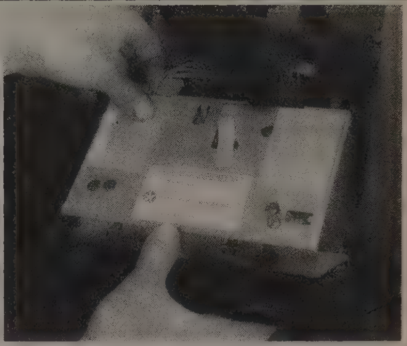
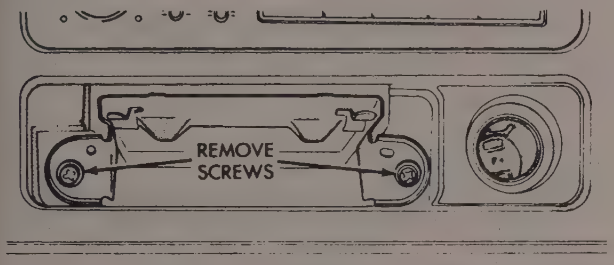
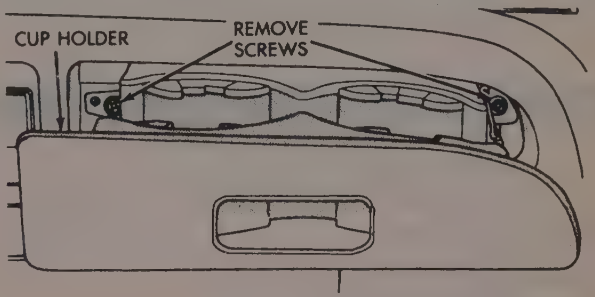

88476P13

Fig. 35 . . . then pull the radio out, and unplug the wiring and antenna leads



88476G72

Fig. 36 Remove the screws securing the ashtray bracket . . .



88476G73

Fig. 37 . . . and the cup holder

Speakers

REMOVAL & INSTALLATION

Door Mounted

1. Remove the door panel.
2. Remove the screws holding the speaker, then pull away from the mounts and separate the wiring.
3. Remove the speaker.
4. Installation is the reverse of removal.

Pillar Mounted

DAKOTA STANDARD CAB

1. Remove the "B" pillar upper seat belt mounting bolt.
2. Remove the four trim panel screws.
3. When pulling the trim panel away from the pillar, remove the wiring connector from the speaker.
4. Remove the speaker attaching screws from the panel, then remove.
5. Installation is the reverse of removal.

DAKOTA EXTENDED CAB

1. Carefully pry the speaker grille off the trim panel. There is a lock tab at each corner of the grille.
2. Remove the speaker attaching hardware.
3. Unplug the speaker connector and remove the speaker.
4. Installation is the reverse of removal.

1994–96 PICK-UPS

1. Remove the rear screw from the sill trim.
2. Remove the two screws holding the "B" pillar trim.
3. Remove the "B" pillar trim as follows
    a. Gently unhook the top two retainer clips by pulling inward and forward.
    b. Remove the two plastic push-in fasteners from the bottom of the panel.
    c. Loosen the rear screws of the cowl/sill trim.
    d. Slide the "B" pillar trim out from under the cowl/sill trim.
4. Move the trim panel far enough to access the speaker screws.
5. Remove the screws holding the speaker.
6. Pull out the speaker, unplug the connector, then remove the speaker.
7. Installation is the reverse of removal.

Rear Mounted

1989–93 CLUB CAB PICK-UP

1. Remove the screws from the bottom of the speaker housing.
2. Lower the speaker housing and pull the bottom out, allowing the retaining tab on top of the housing to clear the slot.
3. Separate the speaker connector and remove the speaker.
4. Installation is the reverse of removal. Tighten each component to specifications.

RAMCHARGER

1. Remove the screws holding the speaker and grille assembly to the mounting plate.
2. Separate the wiring and remove the speaker.
3. Remove the screws holding the speaker to the grille and remove the speaker.
4. Installation is the reverse of removal. Tighten each component to specifications.

WINDSHIELD WIPERS AND WASHERS

Windshield Wiper Blade and Arm

REMOVAL & INSTALLATION

➧ See Figures 38 and 39

To remove the arm from the pivot, lift the arm to permit the latch to be pulled out to the holding position and remove the arm from the pivot with a rocking motion.

When installing the arms, the at-rest position of the blades should be determined before pushing the arm onto the pivot. For Dakota trucks, the tip of the driver's side blade should be 0.51–2.63 in. (13–67mm) above the cowl panel and the passenger's side blade should be 0.94–3.06 in. (24–78mm) above the cowl panel. For 1989–93 Pick-ups and Ramchargers, the driver's side blade should be 1.84 in. (47mm) above the windshield weatherstripping at the heel of the blade; the passenger's side blade should be 2.24 in. (57mm) above the weatherstripping. For 1994–96 Pick-ups, the wiper motor must be in the PARK position and the wiper blade should be about 0.85 in. (22mm) from the upper edge of the black-out areas at the base of the windshield.

Windshield Wiper Motor

REMOVAL & INSTALLATION

Pick-Up and Ramcharger

➧ See Figures 40, 41 and 42

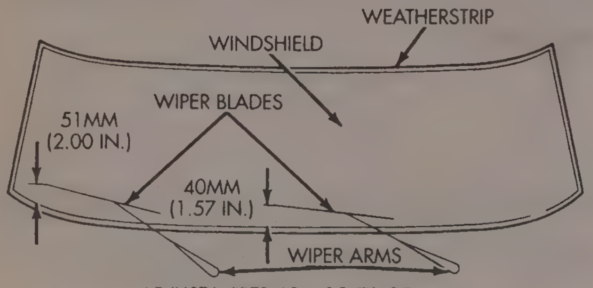
1. Disconnect the negative battery cable.
2. Disconnect the wires from the wiper motor.
3. Remove the mounting bolts.
4. Pull the motor out far enough to gain access to the crank arm to motor link retainer bushing.
5. Remove the crank arm from the drive link by prying the retainer bushing from the crank arm pin with a suitable prying tool.
6. Remove the motor from the vehicle.
7. Hold the crank arm with a wrench while removing the crank nut to prevent from overloading the gears.
8. Remove the crank arm from the motor.

To install:

9. Index the slot correctly and position the crank arm on the motor shaft. Start the crank nut making sure the crank arm does not move from its slotted position.
10. Hold the crank arm with a wrench and torque the nut to 95 inch lbs. (11 Nm).
11. Lubricate the drive link retainer bushing and install the crank arm pin to the bushing by snapping them together suitable pliers.
12. Install the motor to the vehicle and tighten the mounting bolts for 1989–93 models to 65 inch lbs. (7 Nm) and 1994–96 models to 55 inch lbs. (6 Nm).
13. Connect the wires to the motor.
14. Connect the negative battery cable and check the wiper motor for proper operation.

Dakota

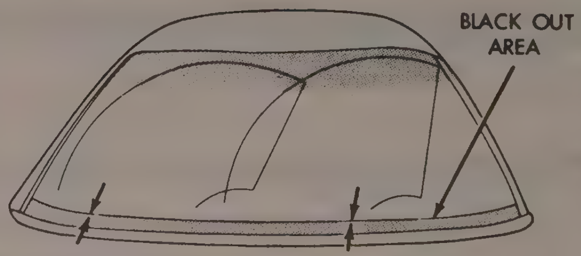
1. Disconnect the negative battery cable.
2. Disconnect the connector from the motor.
3. Remove the wiper arms, raise the hood and remove the cowl panel.
4. Hold the drive crank with a wrench while remove the crank nut. Remove the drive crank.
5. Remove the mounting nuts and remove the motor from the vehicle.
6. The installation is the reverse of the removal procedure.



ADJUST WIPER ARM SO TIP OF BLADE IS ABOVE THE WEATHERSTRIP IN PARK POSITION AS SHOWN ± 27MM (1.06 IN.)

88476G25

Fig. 38 Mount the wiper blade/arm as shown—Dakota models



TIP OF BLADE ± 22MM FROM EDGE OF BLACK OUT

88476G26

Fig. 39 Mount the wiper blade/arm as shown—1994–96 Pick-ups

88476P01

Fig. 40 Remove the bolts securing the motor

88476P02

Fig. 41 Pry the linkage from the pivot using a suitable prytool

88476P03

Fig. 42 Use pliers to squeeze the link back on the pivot ball

7. Connect the negative battery cable and check the wipers for proper operation.

Windshield Washer Pump

REMOVAL & INSTALLATION

1. Remove the screws mounting the washer reservoir to the mounting bracket.
2. Hold the reservoir and disconnect the wiring leads to the washer pump.
3. Remove the pump mounting nut and mounting washer from the reservoir but reaching through the filler cap opening.
4. Remove the pump from the bottom of the washer reservoir. Discard the rubber grommet
5. Installation is the reverse of removal. Fill the reservoir. Check for leaks and pump operation.

INSTRUMENTS AND SWITCHES

Instrument Cluster

REMOVAL & INSTALLATION

1989–93 Pick-Ups and Ramchargers

➧ See Figure 43

1. Disconnect the negative battery cable.
2. Remove the map light.
3. Remove the six screws which attach the faceplate to the base panel. There is a screw below the heater-air conditioning control panel which is not visible from above.
4. If equipped with automatic transmission, place the shift lever in its lowest position.
5. Remove the faceplate by pulling the top edge rearward to clear the brow and pulling the bottom out, disengaging the attaching clips. If the vehicle is equipped with 4WD, disconnect the indicator wires.
6. Remove the upper and lower steering column covers. Disconnect the shift indicator actuator cable from the steering column, if equipped.
7. Loosen the heater and air conditioning control and pull it out enough to clear the cluster housing.
8. Remove the screws that retain the cluster and pull the cluster out far enough to disconnect the speedometer cable by releasing the spring clip.
9. Remove all printed circuit board multiple connectors.
10. Remove the cluster assembly.
11. To remove the speedometer, remove the cluster lens, unplug the EMR timer wires from the speedometer, if equipped and remove the retaining screws.
12. Installation is the reverse of removal. Secure all components.

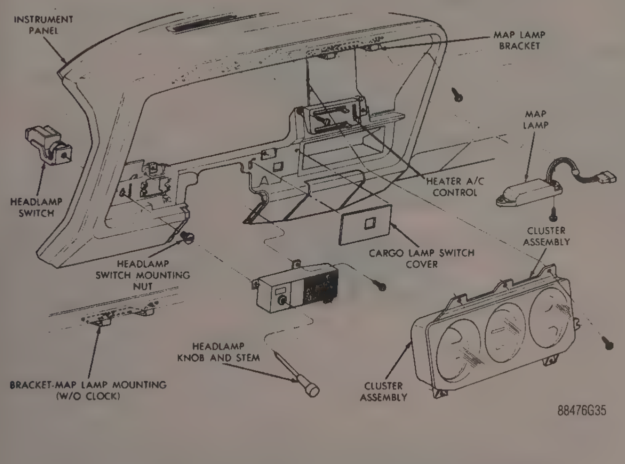

INSTRUMENT PANEL
MAP LAMP BRACKET
MAP LAMP
A
HEADLAMP SWITCH
HEATER A/C CONTROL
CLUSTER ASSEMBLY
HEADLAMP SWITCH MOUNTING NUT
CARGO LAMP SWITCH COVER
HEADLAMP KNOB AND STEM
BRACKET-MAP LAMP MOUNTING (W/O CLOCK)
CLUSTER ASSEMBLY
88476G35

Fig. 43 Exploded view of the instrument cluster and switches—1989–93 Pick-ups and Ramchargers

1994–96 Pick-Ups

➧ See Figures 44 and 45

1. Disconnect the negative battery cable.
2. Remove the cluster bezel as follows:
   a. Remove the cup holder and ash receiver.
   b. Carefully pry the bezel away from the instrument panel to disengage the clips.
   c. Unplug the cigar lighter and auxiliary power outlet connectors.
3. Remove the knee blocker.
4. Pull the PRND21 cable and twist to remove from the position arm, if applicable.
5. Push the tab on the bottom of the cable retainer up, then squeeze the sides to remove the retainer from the column.
6. Remove the four screws that hold the cluster.
7. Pull the cluster rearward and unplug the two electrical connectors.
8. Remove the cluster.
9. Installation is the reverse of removal.

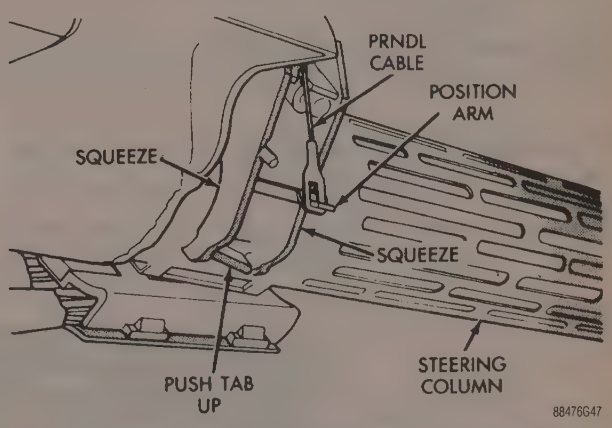

PRNDL CABLE
POSITION ARM
SQUEEZE
SQUEEZE
PUSH TAB UP
STEERING COLUMN
88476G47

Fig. 44 Remove and install the PRND21 cable (if applicable) as shown

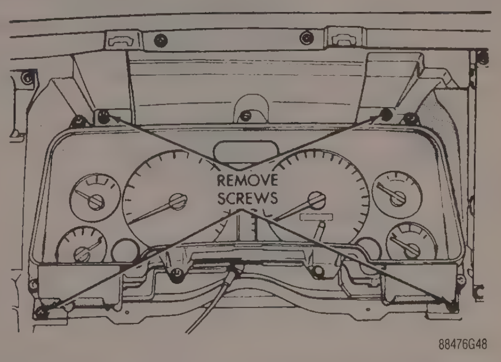

REMOVE SCREWS
88476G48

Fig. 45 Unscrew the instrument cluster from the mounting points indicated

Dakota

➧ **See Figure 46**

1. Disconnect the negative battery cable.
2. Remove the instrument cluster bezel. Cluster removal is not necessary if just removing gauges.
3. When only removing gauge(s) or the speedometer, remove the trip odometer reset knob if equipped, remove the mask and lens assembly and remove the desired gauge from the cluster. Disconnect the speedometer cable if removing the speedometer.
4. If equipped with automatic transmission, remove the lower column cover and disconnect the gear indicator cable.
5. Remove the screws attaching the cluster to the instrument panel.
6. Pull the cluster out and disconnect all wiring and the speedometer cable. Remove the cluster from the vehicle.
7. Installation is the reverse of removal.

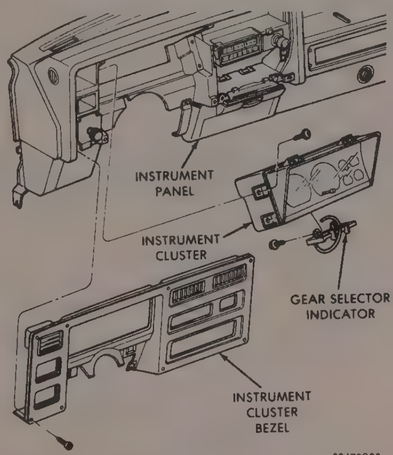

INSTRUMENT PANEL
INSTRUMENT CLUSTER
GEAR SELECTOR INDICATOR
INSTRUMENT CLUSTER BEZEL
88476G38

Fig. 46 Exploded view of the common Dakota instrument cluster and bezel

Speedometer

REMOVAL & INSTALLATION

➧ **See Figure 47**

1. Remove the instrument cluster, then the bezel.
2. Unscrew the instrument from the cluster.
3. Carefully remove the instrument from the front of the cluster.
4. Installation is the reverse of removal.

Speedometer Cable

REMOVAL & INSTALLATION

The 1990–96 models use an electronic speedometer. A wiring harness extends from the speedometer to a distance sensor at the transmission, and an adapter and pinion in the transmission. A signal is sent from the distance sensor to the speedometer controlling the speedometer "needle" reading.1989 models may use a cable-driven system. Replace the cable as follows:

1. Disconnect the negative battery ground cable.
2. Disconnect the fusible link located under the hood.
3. If equipped with a trip odometer, remove the reset knob. Remove the plastic pins fastening the lens to the instrument cluster assembly and remove the lens and mask.
4. Remove the speedometer assembly mounting screws. Depress the tab on the plastic ferrule and disconnect the speedometer from the speedometer cable.
5. Remove the cable core. Install the new cable core into the housing, making sure it seats fully.
6. Place the speedometer in position after connecting the cable. Secure the assembly with the mounting screws. Install the mask, lens and trip odometer knob. Connect the fusible link and battery cable.

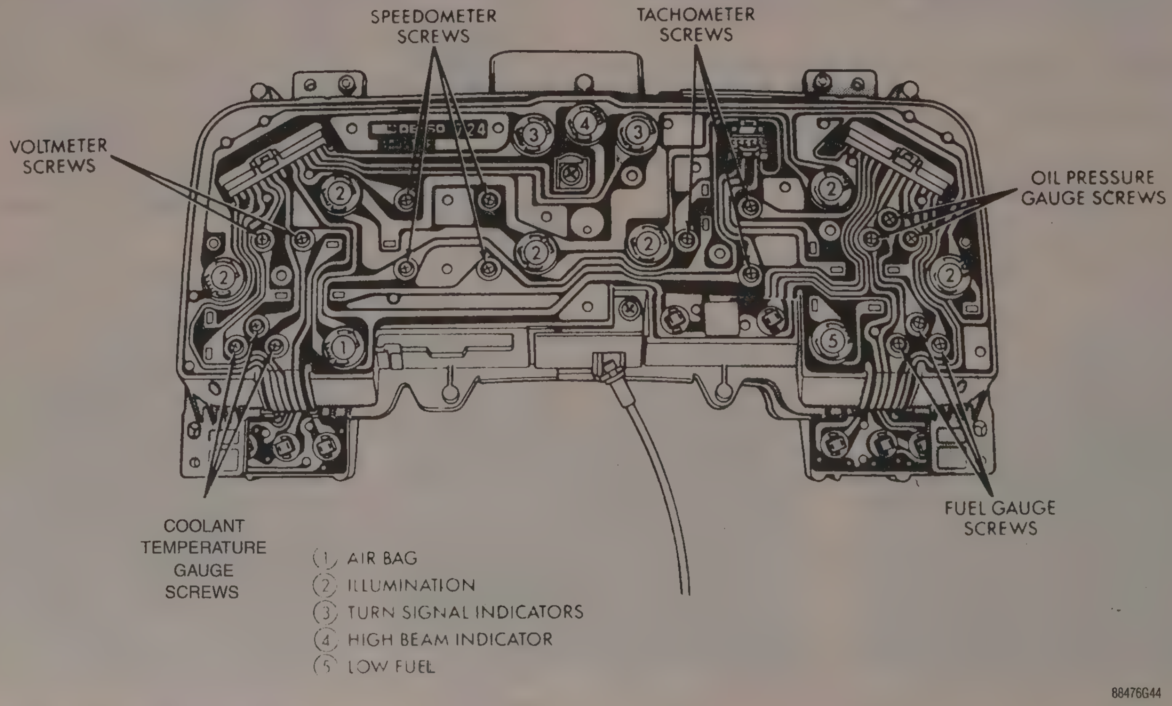

SPEEDOMETER SCREWS
TACHOMETER SCREWS
VOLTMETER SCREWS
OIL PRESSURE GAUGE SCREWS
COOLANT TEMPERATURE GAUGE SCREWS
FUEL GAUGE SCREWS
(1) AIR BAG
(2) ILLUMINATION
(3) TURN SIGNAL INDICATORS
(4) HIGH BEAM INDICATOR
(5) LOW FUEL
88476G44

Fig. 47 Gauge retaining screw locations

Windshield Wiper Switch

REMOVAL & INSTALLATION

1989–93 Column Mounted

EXCEPT TILT WHEEL

1. Disconnect the negative battery cable.
2. Remove the lower steering column cover, if equipped.
3. Remove the horn pad mounting screws from behind the steering wheel and remove the horn pad.
4. Remove the steering wheel nut, matchmark the steering wheel to the shaft and remove the steering wheel with a suitable puller.
5. Remove the plastic wiring channel from the underside of the steering column.
6. Disconnect the wiper switch connector, intermittent wipe module connector and cruise control connector, if equipped.
7. Remove the side lock housing cover.
8. Remove the slotted hex-head screw that attaches the wiper switch to the turn signal switch and remove the switch.
9. Remove the control knob from the end of the stalk. Pull the round nylon hider up the control stalk and remove the revealed screws that attach the control stalk sleeve to the wiper switch.
10. Rotate the control stalk shaft to the full clockwise position and remove the shaft from the wiper switch by pulling it straight out.
11. Installation is the reverse of removal.

TILT WHEEL

See Figures 48 and 49

1. Disconnect the negative battery cable.
2. Remove the lower steering column cover, if equipped, and remove the plastic wiring channel from the underside of the steering column.
3. Remove the horn pad mounting screws from behind the steering wheel and remove the horn pad.
4. Remove the steering wheel nut, matchmark the steering wheel to the shaft and remove the steering wheel with a suitable puller.
5. Depress the lock plate with the proper depressing tool, remove the retaining ring from its groove and remove the tool, ring, lock plate, canceling cam and spring.
6. Remove the switch stalk actuator screw and arm.
7. Remove the hazard switch knob.
8. Disconnect the turn signal switch, wiper switch, intermittent module and cruise control connectors, if equipped.
9. Remove the three screws and remove the turn signal switch. Tape the connector to the wires to aid in removal.
10. Remove the ignition key lamp.
11. Place the key in the **LOCK** position and remove the key. Insert a thin tool into the slot next to the switch mounting screw boss, depress the spring latch at the bottom of the slot releasing the lock. Remove the lock cylinder.
12. Remove the buzzer switch and wedge spring.
13. Remove the three housing cover screws and remove the housing cover.
14. Remove the wiper switch pivot pin with a punch and remove the switch.
15. Remove the control knob from the end of the stalk. Pull the round nylon hider up the control stalk and remove the revealed screws that attach the control stalk sleeve to the wiper switch.
16. Rotate the control stalk shaft to the full clockwise position and remove the shaft from the wiper switch by pulling it straight out.
17. Installation is the reverse of removal.

1994–96 Models

See Figures 50 and 51

➡This switch is referred to (in Mopar terminology) as the "Multi-function Switch." To remove the switch, a tamper resistant Torx® bit, such as the Snap-on® TTXR20B2, or equivalent, is required.

1. Disconnect the negative battery cable.
2. Remove the tilt steering column lever, if equipped.
3. Remove the lower fixed column shroud.

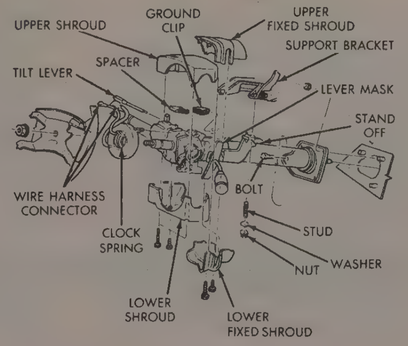

UPPER SHROUD
GROUND CLIP
UPPER FIXED SHROUD
SUPPORT BRACKET
SPACER
TILT LEVER
LEVER MASK
STAND OFF
WIRE HARNESS CONNECTOR
BOLT
CLOCK SPRING
STUD
WASHER
NUT
LOWER SHROUD
LOWER FIXED SHROUD
88476G55

Fig. 48 Exploded view of the steering column and its covers—1989–93 Pick-up and Ramcharger

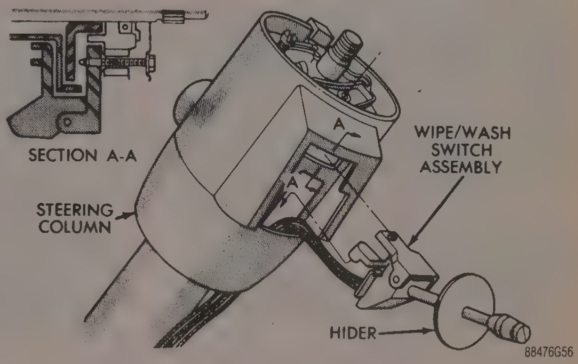

SECTION A-A
A
A
WIPE/WASH SWITCH ASSEMBLY
STEERING COLUMN
HIDER
88476G56

Fig. 49 A common windshield wiper/washer switch—Dakota models

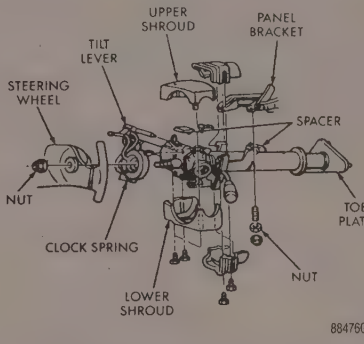

UPPER SHROUD
PANEL BRACKET
TILT LEVER
STEERING WHEEL
SPACER
NUT
TOE PLATE
CLOCK SPRING
NUT
LOWER SHROUD
88476G49

Fig. 50 Remove the steering column shrouds for access to the multi-function switch as shown in this exploded view—1994–96 models

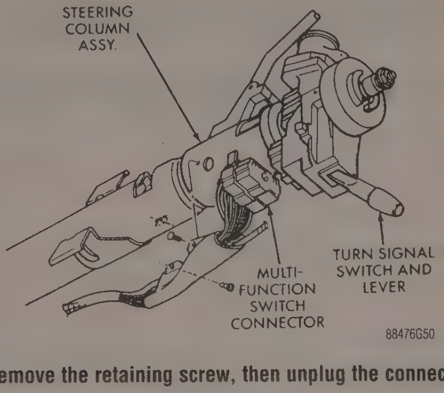

STEERING COLUMN ASSY.
TURN SIGNAL SWITCH AND LEVER
MULTI-FUNCTION SWITCH CONNECTOR
88476G50

Fig. 51 Remove the retaining screw, then unplug the connector to the multi-function switch—1994–96 models

4. Move the upper fixed column shroud to gain access to the rear of the multi-function switch.
5. Remove the multi-function switch tamper resistant mounting screws using the correct tamper resistant, such as a Snap-on® tamper proof Torx® bit TTXR20B2, or equivalent.
6. Gently pull the switch away from the column. Loosen the connector screw. The screw will remain in the connector.
7. Remove the wiring connector from the multi-function switch.
8. Installation is the reverse of removal.

Headlight Switch

REMOVAL & INSTALLATION

Dakota

1. Disconnect the negative battery cable.
2. Remove the steering column cover and remove the instrument panel bezel. Two screws are hidden behind the steering column cover.
3. Remove the screws from the headlight switch bezel, pull the assembly out and disconnect the wiring.
4. Remove the nut retaining the bezel to the bracket. Depress the spring button on the right side of the switch and remove the headlight switch knob and stem.
5. Remove the spanner nut and remove the switch.
6. The installation is the reverse of the removal procedure.

1989–93 Pick-Ups and Ramchargers

➧ See Figure 52

1. Disconnect the negative battery cable.
2. Remove the map light.
3. Remove screws which attach the faceplate to the base panel. There is a screw below the heater-air conditioning control panel which is not visible from above.
4. If equipped with automatic transmission, place the shift lever in its lowest position.
5. Remove the faceplate by pulling the top edge rearward to clear the brow and pulling the bottom out, disengaging the attaching clips. If the vehicle is equipped with 4WD, disconnect the indicator wires.
6. Reach under the instrument panel, depress the spring button and remove the headlight switch knob.
7. Remove the wiper and power mirror switch knobs off their levers, if equipped.
8. Remove the bezel.
9. Remove the switch mounting nut from the panel, remove the switch and disconnect the wiring.
10. Installation is the reverse of removal. Connect the negative battery cable and check the switch for proper operation.

1994–96 Pick-Ups

➧ See Figure 53

1. Remove the cluster bezel (as described in the instrument panel removal procedure).

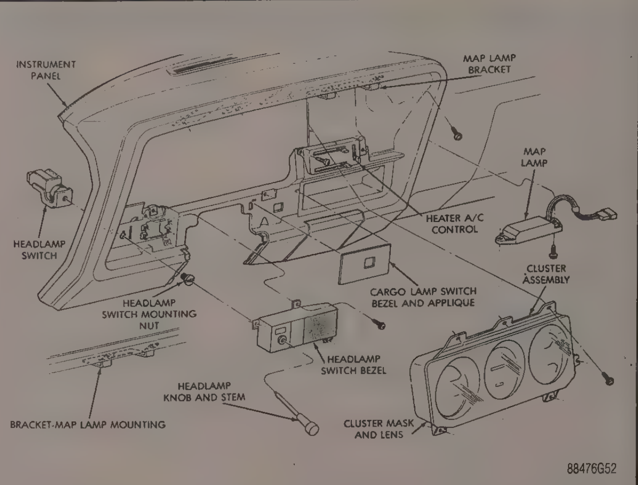


Fig. 52 Exploded view of the instrument panel switch mounting—1989–93 Pick-ups and Ramchargers

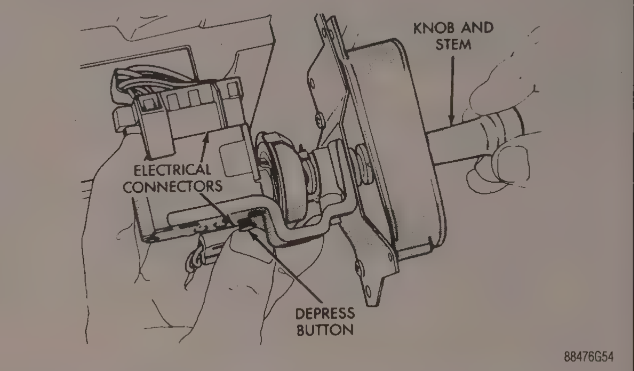


Fig. 53 Depress the button on the switch housing, then pull to remove the knob and stem—1994–96 Pick-ups

2. Remove the switch retaining three screws. Remove the switch and bezel from the instrument panel.
3. Unplug the two harness connectors from the headlight switch.
4. Pull the headlight switch knob and stem out to its stop. Depress the button on the bottom of the switch housing, then pull to remove the knob and stem from the switch.
5. Installation is the reverse of removal.

LIGHTING

Headlights

REMOVAL & INSTALLATION

➧ See Figures 54 thru 62

➡To access the bulb on 1994–96 models, you can reach behind the lamp, unplug and disconnect the halogen bulb.

1. On 1994–96 Pick-ups, open the hood for access to the mounting screws.
2. Remove the headlight bezel attaching screws and remove the bezel. On some models it may not be necessary to remove the bezel, depending on whether the headlight retaining ring is accessible.

✻✻ WARNING

When dealing with replaceable halogen bulbs, never touch the glass. If you do, traces of oil from your fingerprints will cause premature failure of the bulb.

3. Remove the headlight ring attaching screws and remove the ring. Do not touch the headlight aiming screws.
4. Pull the lamp assembly out slightly and unplug the connector.

To install:

➡As long as the adjusting screws were not moved, the headlight will be held in proper adjustment by the retaining ring.

5. Plug in the wiring to the light.

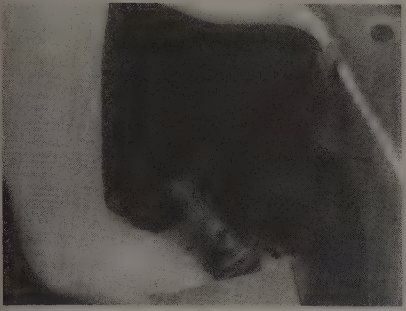


Fig. 54 Late models have bulbs which are replaceable from behind the lamp housing—1994 Pick-up shown

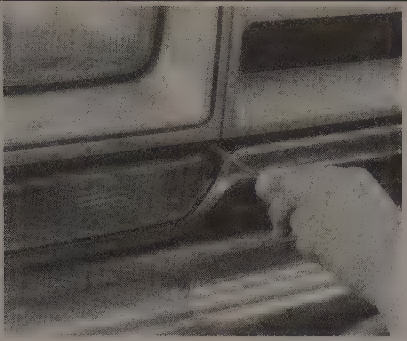


Fig. 55 Unscrew the bezel attaching screws for headlight/turn signal access

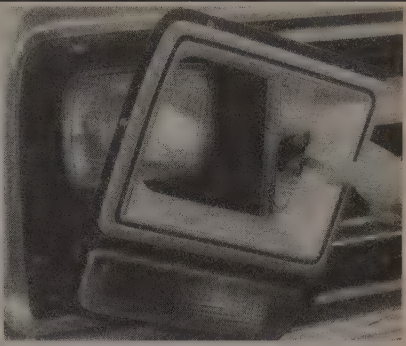


Fig. 56 Lift it away and set the bezel in a safe location with the mounting hardware

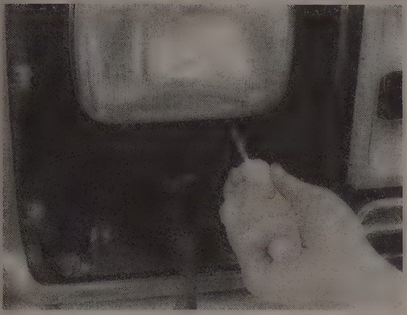


Fig. 57 Unscrew the sealed beam headlight—do not disturb the aiming adjustment screws

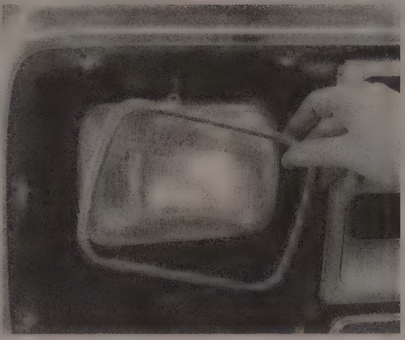


Fig. 58 Remove the trim ring from the headlight

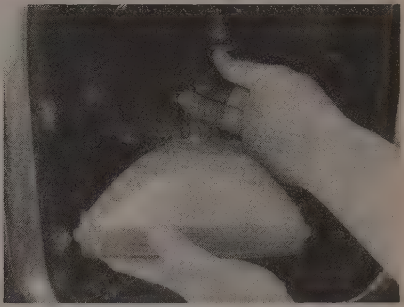


Fig. 59 Support the sealed beam in one hand and unplug the wiring by pulling on the connector

6. Install the headlight assembly.
7. If applicable, install the park and turn signal lamp.
8. Close the hood on 1994–96 Pick-ups.

AIMING

The headlights must be properly aimed to provide the best, safest road illumination. The lights should be checked for proper aim and adjusted as necessary. Certain state and local authorities have requirements for headlight aiming; these should be checked before adjustment is made.

Each headlight is adjusted by means of two screws located at the 12 o'clock and 9 o'clock positions on the headlight underneath the trim ring. Always bring each beam into final position by turning the adjusting screws clockwise so that the headlight will be held against the tension springs when the operation is completed.

Headlight adjustment may be temporarily made using a wall, as described below, or on the rear of another vehicle. When adjusted, the lights should not glare in oncoming car or truck windshields, nor should they illuminate the passenger compartment of vehicles driving in front of you. These adjustments are rough and should always be fine-tuned by a repair shop which is equipped with headlight aiming tools. Improper adjustments may be both dangerous and illegal.

Before making any headlight adjustments, perform the following preparatory steps:

1. Make sure all tires are properly inflated.
2. Take into consideration any faulty wheel alignment or improper rear axle tracking.
3. Make sure there is no load in the truck other than the driver.
4. The truck's fuel tank should be about half full.
5. Make sure all lenses are clean.

To adjust:

6. Park the truck on a level surface, with the fuel tank no more than ½ full

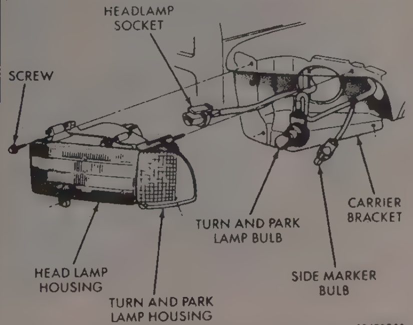

HEADLAMP SOCKET
SCREW
CARRIER BRACKET
TURN AND PARK LAMP BULB
HEAD LAMP HOUSING
SIDE MARKER BULB
TURN AND PARK LAMP HOUSING
88476G66

Fig. 60 Exploded view of the combination headlight/turn signal/parking lamp assembly mounting—1994–96 Pick-ups

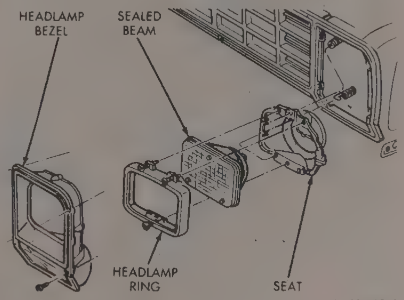

HEADLAMP BEZEL
SEALED BEAM
HEADLAMP RING
SEAT
88476G59

Fig. 61 Exploded view of the headlight assembly—1989–93 Pick-ups and Ramchargers

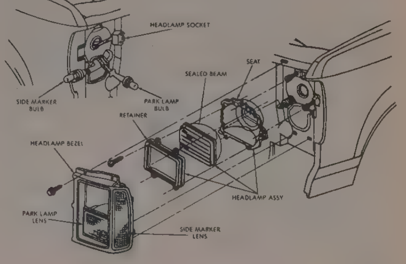

HEADLAMP SOCKET
SEAT
SEALED BEAM
SIDE MARKER BULB
PARK LAMP BULB
RETAINER
HEADLAMP BEZEL
HEADLAMP ASSY
PARK LAMP LENS
SIDE MARKER LENS
88476G60

Fig. 62 Exploded view of the headlight and side marker assembly—Dakota models

and with the vehicle empty of all extra cargo (unless normally carried). The vehicle should be facing a wall which is no less than 6 feet (1.8m) high and 12 feet (3.7m) wide. The front of the vehicle should be about 25 feet (7.6m) from the wall.

7. If this is be performed outdoors, it is advisable to wait until dusk in order to properly see the headlight beams on the wall. If done in a garage, darken the area around the wall as much as possible by closing shades or hanging cloth over the windows.

8. Turn the headlights **ON** and mark the wall at the center of each light's low beam, then switch on the "brights" and mark the center of each light's high beam. A short length of masking tape which is visible from the front of the truck may be used. Although marking all 4 positions is advisable, marking 1 position from each light should be sufficient.

9. If neither beam on 1 side of the vehicle is working, park another like-sized truck in the exact spot where the truck was and mark the beams using the same side light on that truck. Then switch the trucks so the truck being worked on is back in the original spot. The truck must be parked no closer to or farther away from the wall than the second vehicle.

10. Perform the necessary repairs, but make sure the truck is not moved or is returned to the exact spot from which the lights were marked. Turn the headlights ON and adjust the beams to match the marks on the wall.

11. Have the headlight adjustment checked as soon as possible by a reputable repair shop.

Signal and Marker Lights

REMOVAL & INSTALLATION

1. Remove the lens screws.
2. Pull off the lens, turn the bulb and pull it out of its socket.
3. Place the bulb into the socket and turn it to secure the mounting lugs. Install and secure the lens.

Front Turn Signal and Parking Lights

REMOVAL & INSTALLATION

See Figures 63, 64 and 65

1. Remove the lens screws.
2. Pull off the lens, turn the bulb and pull it out of its socket.
3. Place the bulb into the socket and turn it to secure the mounting lugs.
4. Install and secure the lens.

Side Marker Lights

REMOVAL & INSTALLATION

1. Remove the lens screws.
2. Pull off the lens, turn the bulb and pull it out of its socket.
3. Place the bulb into the socket and turn it to secure the mounting lugs. Install and secure the lens.

Rear Turn Signal, Brake and Parking Lights

REMOVAL & INSTALLATION

See Figures 66, 67, 68 and 69

1. Remove the lens screws.
2. Pull off the lens, turn the bulb and pull it out of its socket.
3. Place the bulb into the socket and turn it to secure the mounting lugs. Install and secure the lens.

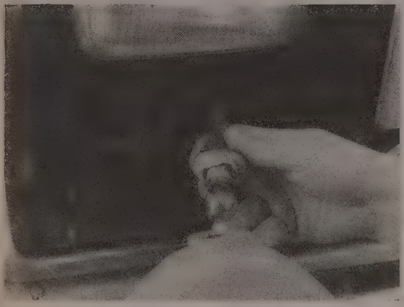


Fig. 63 Twist to disengage, then pull the socket from the back of the turn signal lamp assembly

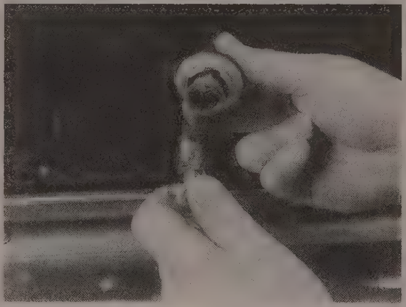


Fig. 64 Depress the bulb and twist it 1/8 turn counterclockwise to disengage it from the socket

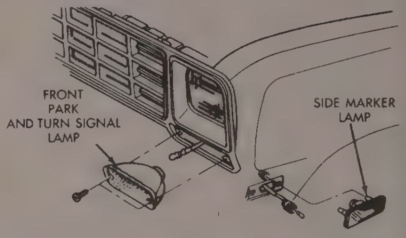


Fig. 65 Exploded view of the parking, turn signal and side marker light assembly—Pick-up and Ramcharger

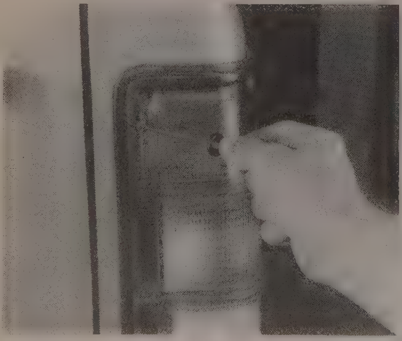


Fig. 66 Unscrew the tail light lens in order to remove it from the body

Fig. 67 Pull the lens free of the truck

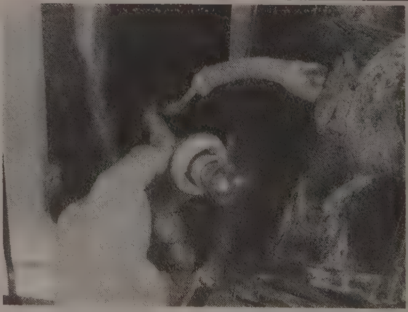


Fig. 68 Pull the bulb socket and wiring out from behind the particular lamp you are servicing

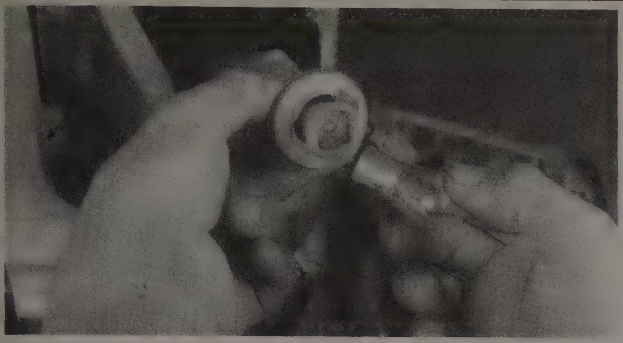


Fig. 69 Depress the bulb and twist it 1/8 turn counterclockwise In disengage it from the socket

High-Mount Brake Light

REMOVAL & INSTALLATION

➧ **See Figure 70**

➡**This light is called a Center High Mounted Stop Lamp (CHMSL) in Mopar terminology.**

1. Remove the screws holding the lamp to the roof panel.
2. Separate the lamp from the roof, disengage the wiring and remove the lamp from the vehicle.
3. Installation is the reverse of removal.

Cab Mounted Roof Marker Lights

REMOVAL & INSTALLATION

➧ **See Figure 71**

1. For each lens: remove the screws holding the clearance lamp to the roof panel.
2. Rotate the socket about ¼ turn counterclockwise and separate the lamp from the socket.

To install:

3. Install the lamp on the socket and rotate clockwise ¼ turn.
4. Position the lamp on the roof. Install the screws, tightening each to 13 inch lbs. (1 Nm).

Dome/Reading Light

REMOVAL & INSTALLATION

➧ **See Figure 72**

Gently squeeze the front and rear of the dome light lens together and pull down to remove it. Pull the bulb down and out of the socket. Push the new bulb into the socket and install the dome cover.

Remove the screws that mount the lamp housing. Remove the housing, and rotate the build out of the mounting socket. Install a new bulb and secure the housing.

License Plate Light

REMOVAL & INSTALLATION

➧ **See Figures 73, 74 and 75**

1. Remove the lens screws.
2. Pull off the lens and pull the bulb out of its socket.
3. Place the bulb into the socket and turn it to secure the mounting lugs. Install and secure the lens.

Fog Lights

REMOVAL & INSTALLATION

➡**The fog lights are serviced from the rearward side of the front bumper.**

1. Unplug the fog light wiring.
2. Remove the fog light mounting nuts.
3. Remove the fog light.
4. Installation is the reverse of removal.

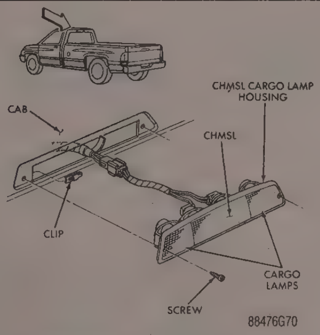


Fig. 70 Mounting position of the high-mounted stop lamp—1994–96 Pick-up shown

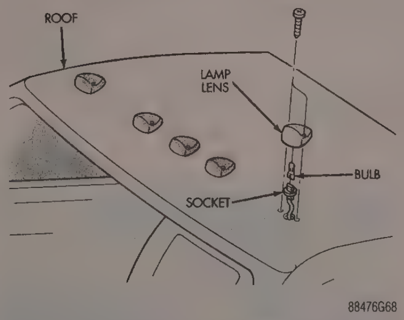


Fig. 71 Exploded view of the roof clearance lamp mounting—1994–96 Pick-up shown; others similar

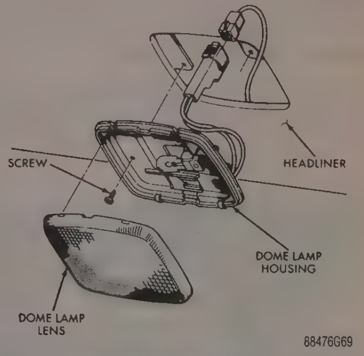


Fig. 72 Typical exploded view of the dome lamp

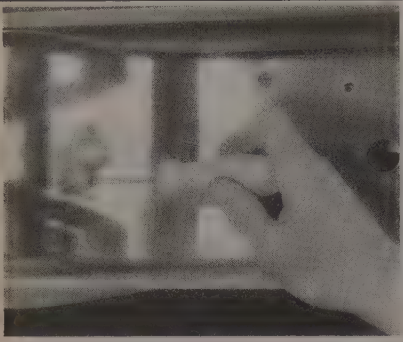


Fig. 73 Remove the license plate light retaining screws

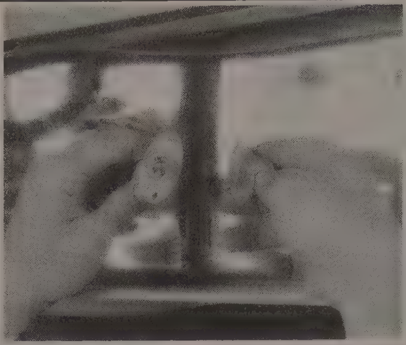


Fig. 74 Separate the cover (lens) from the socket

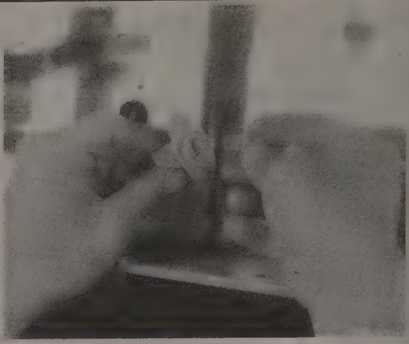


Fig. 75 Pull the bulb straight out of its socket

TRAILER WIRING

Wiring the vehicle for towing is fairly easy. There are a number of good wiring kits available and these should be used, rather than trying to design your own.

All trailers will need brake lights and turn signals as well as tail lights and side marker lights. Most states require extra marker lights for over-wide trailers. Also, most states have recently required back-up lights for trailers, and most trailer manufacturers have been building trailers with back-up lights for several years.

Additionally, some Class I, most Class II and just about all Class III trailers will have electric brakes. Add to this number an accessories wire, to operate trailer internal equipment or to charge the trailer's battery, and you can have as many as seven wires in the harness.

Determine the equipment on your trailer and buy the wiring kit necessary. The kit will contain all the wires needed, plus a plug adapter set which included the female plug, mounted on the bumper or hitch, and the male plug, wired into, or plugged into the trailer harness.

When installing the kit, follow the manufacturer's instructions. The color coding of the wires is usually standard throughout the industry. One point to note: some domestic vehicles, and most imported vehicles, have separate turn signals. On most domestic vehicles, the brake lights and rear turn signals operate with the same bulb. For those vehicles with separate turn signals, you can purchase an isolation unit so that the brake lights won't blink whenever the turn signals are operated, or, you can go to your local electronics supply house and buy four diodes to wire in series with the brake and turn signal bulbs. Diodes will isolate the brake and turn signals. The choice is yours. The isolation units are simple and quick to install, but far more expensive than the diodes. The diodes, however, require more work to install properly, since they require the cutting of each bulb's wire and soldering in place of the diode.

One, final point, the best kits are those with a spring loaded cover on the vehicle mounted socket. This cover prevent dirt and moisture from corroding the terminals. Never let the vehicle socket hang loosely; always mount it securely to the bumper or hitch.

CIRCUIT PROTECTION

Fuses

LOCATION

See Figures 76, 77 and 78

The fuse panel box is to the right of the glove box with the glove box door opened or beneath the instrument panel (dashboard) on 1989–93 models. For 1994–96 Pick-ups, it is beneath the knee blocker panel.

Circuit Breakers

LOCATION

Two circuit are protected by circuit breakers located in the fuse panel: the power windows (20 amp) and the power door locks (30 amp). The breakers are self-resetting.

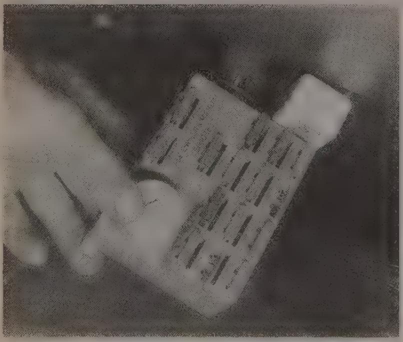


Fig. 76 Pull out the fuse panel for access to the blade type fuses

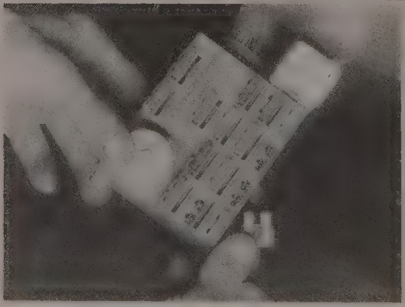


Fig. 77 Although you can often pull the fuses out by hand, convenient puller tools are available

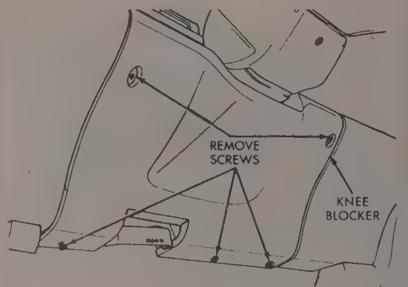


Fig. 78 Remove the knee blocker to access the fuseblock—1994–96 Pick-ups

Turn Signal and Hazard Flashers

LOCATION

The flashers are located at the back of the dash panel. To replace the flasher(s), open the glove box door. Depress the top and bottom edges of the box together, lift upwards and remove the box. Reach through the opening and change the flasher(s).

Fusible Links

REPLACEMENT

The fusible link is a short length of special, Hypalon (high temperature) insulated wire, integral with the engine compartment wiring harness, and should not be confused with standard wire. It is several wire gauges smaller than the circuit which it protects. Under no circumstances should a fusible link replacement repair be made using a length of standard wire cut from bulk stock or from another wiring harness.

When a fusible link blows it is very important to find out the cause. Do not just replace the link to correct the problem. The fusible links are placed in the system for protection against dead shorts to ground.

In some instances the link may be blown and it will not show through the insulation. Check the entire length of the fusible wire when the link is suspected of failure.

To repair any blown fusible link use the following procedure:

1. Determine which circuit is damaged, its location and the cause of the open fusible link. If the damaged link is one of three fed by a common No. 10 or 12 gauge feed wire, determine the specific affected circuit.
2. Disconnect the negative battery cable.
3. Cut the damaged fusible link from the wiring harness and discard it. If the link is one of three circuits fed by a single feed wire, cut it out of the harness at each splice end and discard it.
4. Identify and procure the proper fusible link and butt connectors for attaching the link to the harness.

➡Care must be taken when fitting the three fusible links into the butt connector as the internal diameter is a snug fit for three wires. Make sure to use a proper crimping tool. Pliers, side cutters, etc. will not apply the proper crimp to retain the wires and withstand a pull test.

5. To repair any fusible link in a 3-link group with one feed:
   a. After cutting the open link out of the harness, cut each of the remaining undamaged fusible links close to the feed wire weld.
   b. Strip approximately ½ in. (13mm) of insulation from the detached ends of the two good links. Then, insert two wire ends into one end of a butt connector and carefully push one stripped end of the replacement fusible link into the same end of the butt connector and crimp all three firmly together.
   c. After crimping the butt connector to the three fusible links, cut the weld portion from the feed wire and strip approximately ½ in. (13mm) of insulation from the cut end. Insert the stripped end into the open end of the butt connector and crimp very firmly.
   d. To attach the remaining end of the replacement fusible link, strip approximately ½ in. (13mm) of insulation from the wire end of the circuit from which the blown link was removed, and firmly crimp a butt connector or equivalent to the stripped wire. Then, insert the end of the replacement link into the other end of the butt connector and crimp firmly.
   e. Using rosin core solder with a consistency of 60 percent tin and 40 percent lead, solder the connectors and the wires at the repairs and insulate with electrical tape.
6. To replace any fusible link on a single circuit in a harness, cut out the damaged portion, strip approximately ½ in. (13mm) of insulation from the two wire ends and attach the appropriate replacement link to the stripped wire ends with two proper size butt connectors. Solder the connectors and wires, then insulate with tape.
7. To repair any fusible link which has an eyelet terminal on one end, such as the charging circuit, cut off the open fusible link behind the weld, strip approximately ½ in. (13mm) of insulation from the cut end and attach the appropriate new eyelet fusible link to the cut stripped wire with an appropriate size butt connector. Solder the connectors and wires at the repair and insulate with tape.
8. Connect the negative battery cable to the battery and test the system for proper operation.

➡Do not mistake a resistor wire for a fusible link. The resistor wire is generally longer and has print stating, "Resistor: don't cut or splice." DO NOT replace blown fusible links with standard wire. Use only fusible type wire with hypalon insulation or damage to the electrical system could occur. Make sure the correct gauge of wiring is used.

WIRING DIAGRAMS

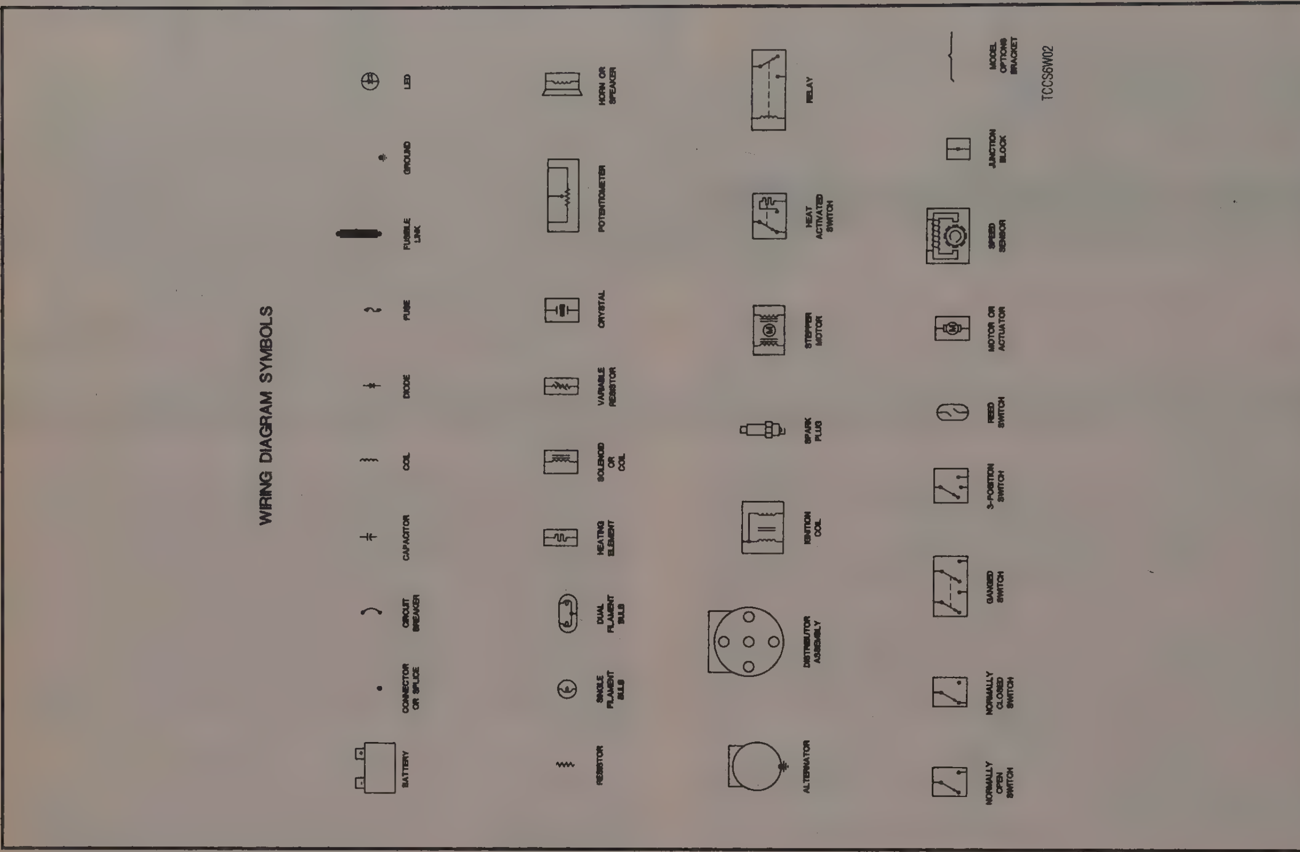

WIRING DIAGRAM SYMBOLS
BATTERY
CONNECTOR OR SPLICE
CIRCUIT BREAKER
CAPACITOR
COIL
DIODE
FUSE
FUSIBLE LINK
GROUND
LED
RESISTOR
SINGLE FILAMENT BULB
DUAL FILAMENT BULB
HEATING ELEMENT
SOLENOID OR COIL
VARIABLE RESISTOR
CRYSTAL
POTENTIOMETER
HORN OR SPEAKER
ALTERNATOR
DISTRIBUTOR ASSEMBLY
IGNITION COIL
SPARK PLUG
STEPPER MOTOR
HEAT ACTIVATED SWITCH
RELAY
NORMALLY OPEN SWITCH
NORMALLY CLOSED SWITCH
GANGED SWITCH
3-POSITION SWITCH
REED SWITCH
MOTOR OR ACTUATOR
SPEED SENSOR
JUNCTION BLOCK
MODEL OPTIONS BRACKET
TCCS6W02

Fig. 80 Common wiring diagram symbols

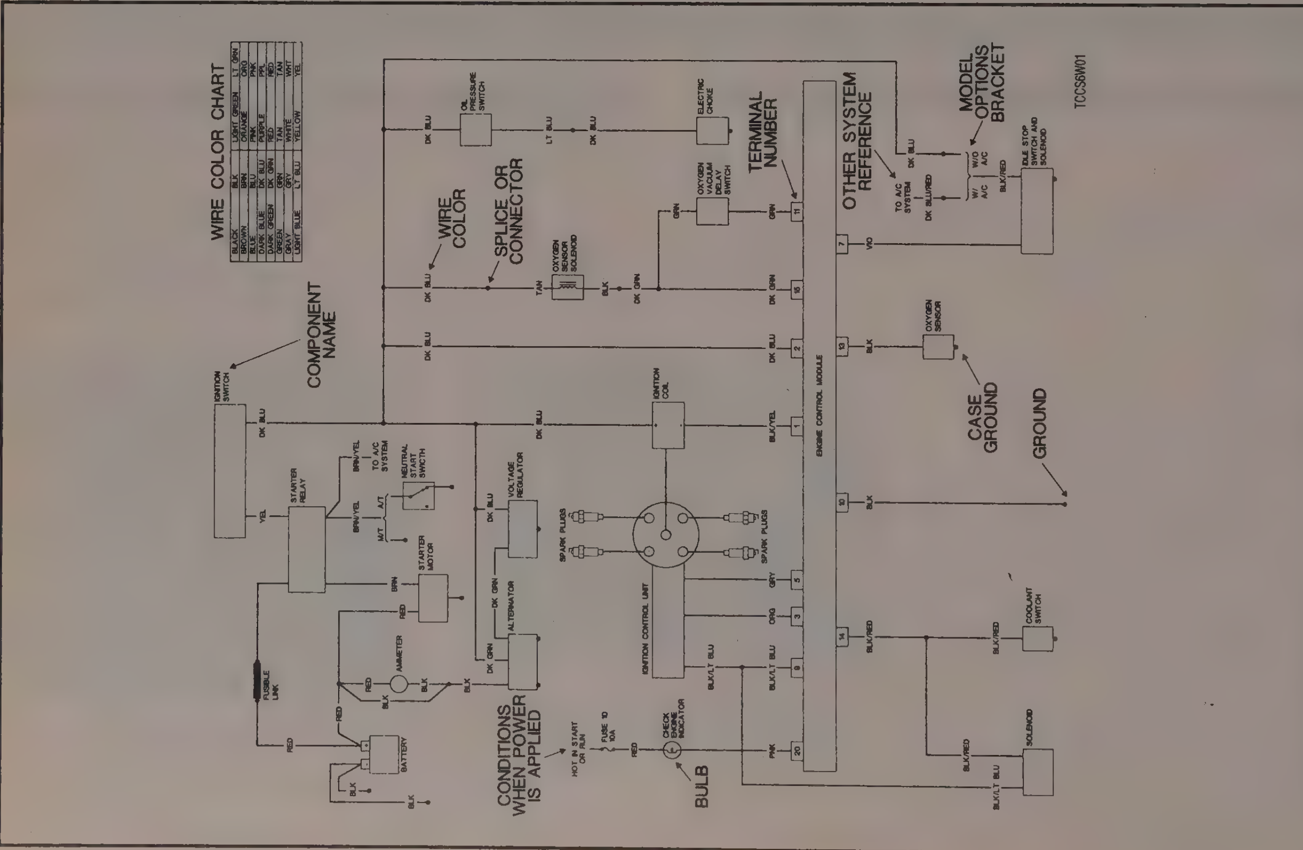

WIRE COLOR CHART
BLACK BLK
BROWN BRN
BLUE BLU
DARK BLUE DK BLU
DARK GREEN DK GRN
GREEN GRN
GRAY GRY
LIGHT BLUE LT BLU
LIGHT GREEN LT GRN
ORANGE ORG
PINK PNK
PURPLE PPL
RED RED
TAN TAN
WHITE WHT
YELLOW YEL
COMPONENT NAME
IGNITION SWITCH
WIRE COLOR
SPLICE OR CONNECTOR
TERMINAL NUMBER
OTHER SYSTEM REFERENCE
MODEL OPTIONS BRACKET
CASE GROUND
GROUND
CONDITIONS WHEN POWER IS APPLIED
BULB
HOT IN START OR RUN
FUSE 10 10A
CHECK ENGINE INDICATOR
BATTERY
FUSIBLE LINK
AMMETER
ALTERNATOR
STARTER MOTOR
STARTER RELAY
NEUTRAL START SWITCH
TO A/C SYSTEM
VOLTAGE REGULATOR
IGNITION COIL
SPARK PLUGS
IGNITION CONTROL UNIT
ENGINE CONTROL MODULE
OIL PRESSURE SWITCH
ELECTRIC CHOKE
OXYGEN SENSOR SOLENOID
OXYGEN VACUUM DELAY SWITCH
OXYGEN SENSOR
W/O A/C
W/ A/C
IDLE STOP SWITCH AND SOLENOID
COOLANT SWITCH
SOLENOID
TCCS6W01

Fig. 79 Sample diagram—how to read and interpret wiring

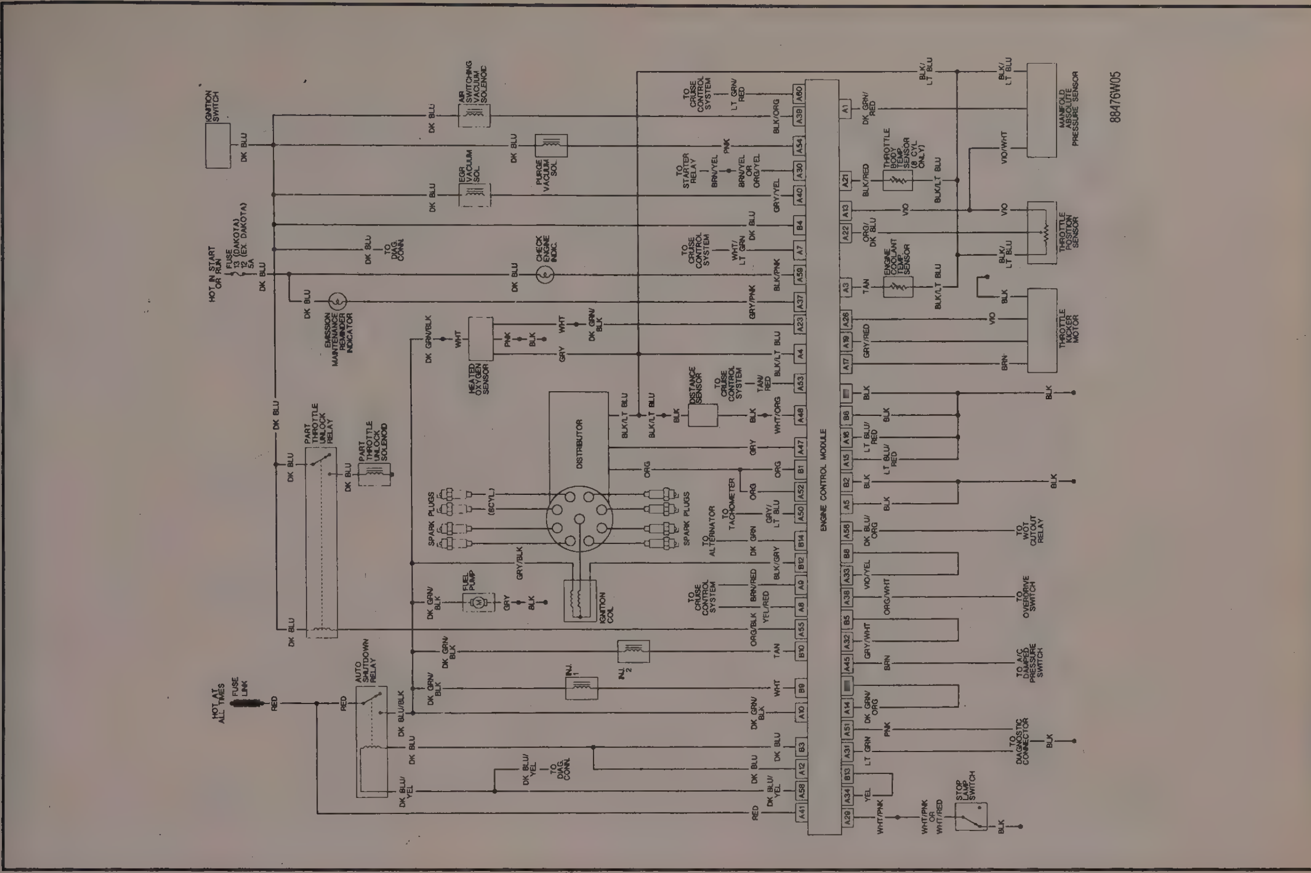


Fig. 82 Engine wiring—1989 3.9L, 5.2L and 5.9L gasoline engines (all models)

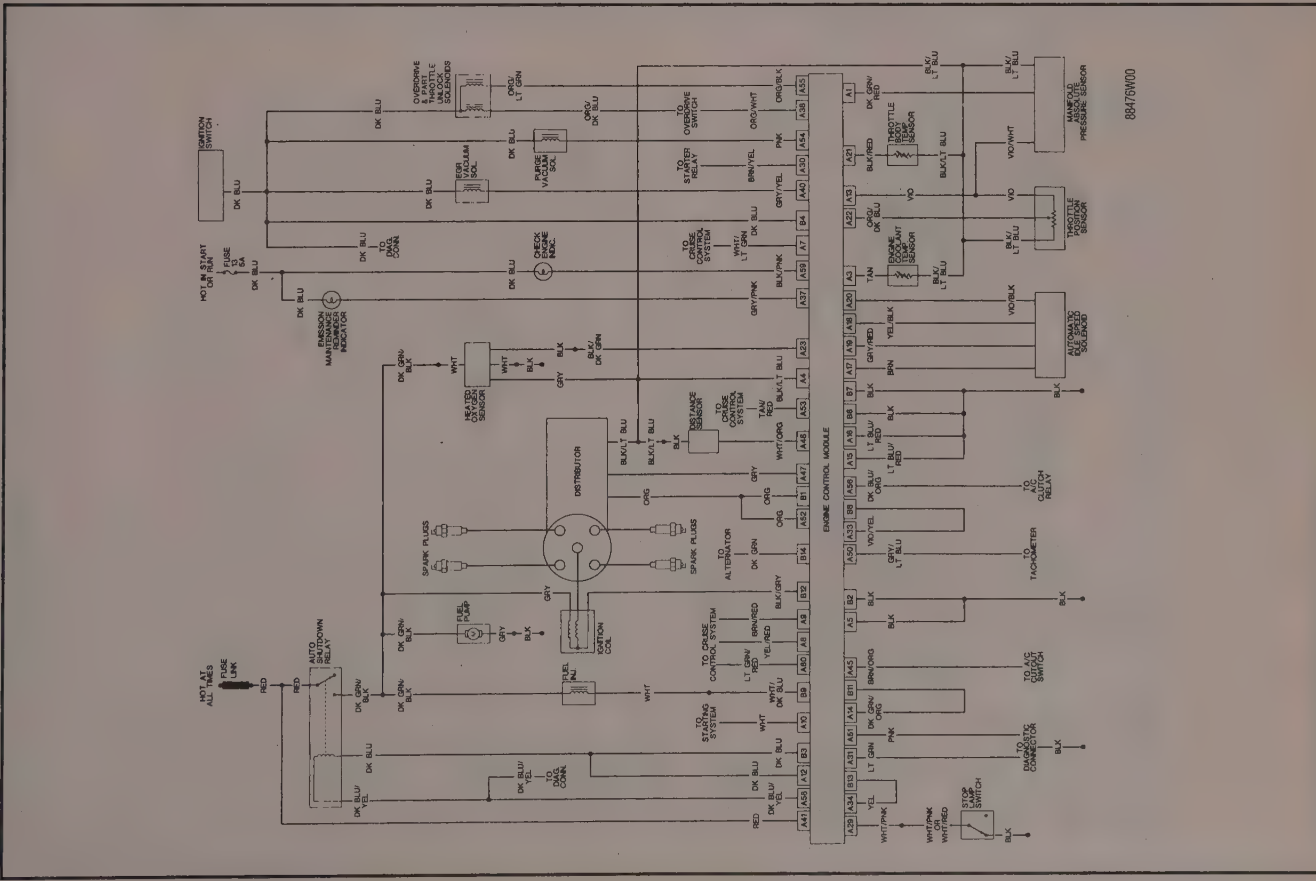


Fig. 81 Engine wiring—1989 2.5L Dakota

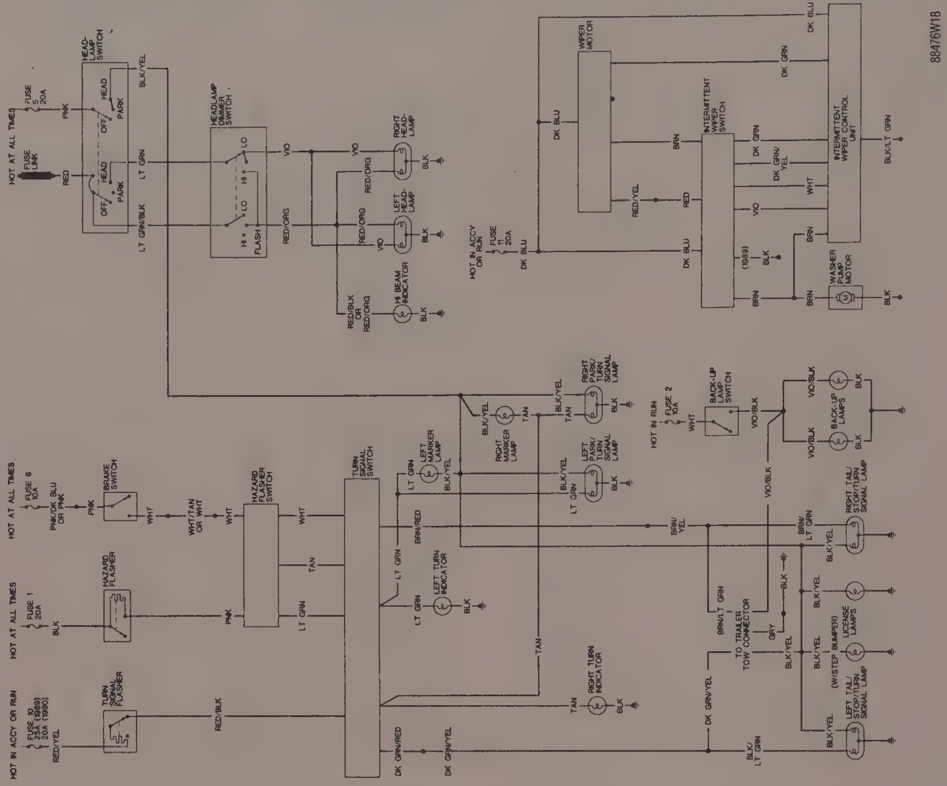

HOT AT ALL TIMES
FUSE LINK
FUSE 5 20A
PNK
RED
HEAD-LAMP SWITCH
OFF
HEAD
PARK
BLK/YEL
LT GRN
LT GRN/BLK
HEADLAMP DIMMER SWITCH
LO
HI
FLASH
VIO
RED/ORG
RIGHT HEAD-LAMP
LEFT HEAD-LAMP
HI BEAM INDICATOR
RED/BLK OR RED/ORG
BLK
HOT IN ACCY OR RUN
FUSE 11 20A
DK BLU
WIPER MOTOR
INTERMITTENT WIPER SWITCH
INTERMITTENT WIPER CONTROL UNIT
DK GRN
DK GRN/YEL
WHT
BRN
RED/YEL
(1989)
WASHER PUMP MOTOR
BLK/LT GRN
88476W18
HOT AT ALL TIMES
FUSE 6 10A
PNK/DK BLU OR PNK
BRAKE SWITCH
WHT/TAN OR WHT
HAZARD FLASHER SWITCH
TURN SIGNAL SWITCH
FUSE 1 20A
HAZARD FLASHER
HOT IN ACCY OR RUN
FUSE 10 25A (1989) 20A (1990)
RED/YEL
TURN SIGNAL FLASHER
RED/BLK
TAN
DK GRN/RED
DK GRN/YEL
LEFT MARKER LAMP
RIGHT MARKER LAMP
LEFT INDICATOR
RIGHT TURN INDICATOR
BRN/RED
LEFT PARK/TURN SIGNAL LAMP
RIGHT PARK/TURN SIGNAL LAMP
HOT IN RUN
FUSE 2 10A
BACK-UP LAMP SWITCH
VIO/BLK
BACK-UP LAMPS
BRN/YEL
BRN/LT GRN
TO TRAILER TOW CONNECTOR
GRY
RIGHT TAIL/STOP/TURN SIGNAL LAMP
LICENSE LAMPS
(W/STEP BUMPER)
LEFT TAIL/STOP/TURN SIGNAL LAMP
BLK/LT GRN

Fig. 84 Chassis wiring—1989–90 Dakotas (continued)

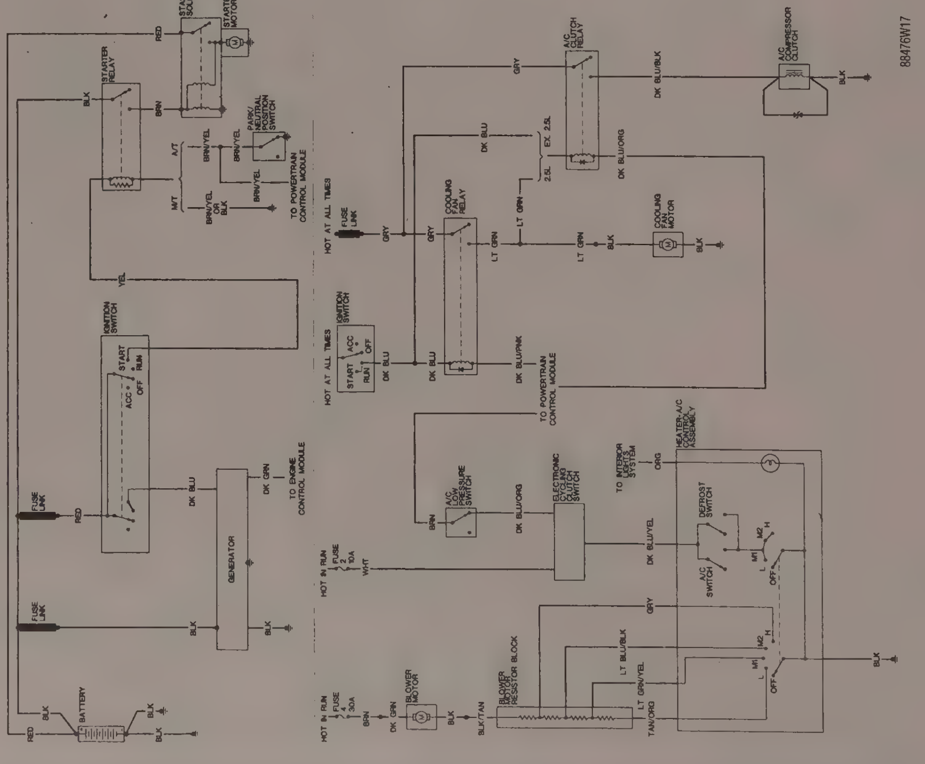

RED
STARTER SOLENOID
STARTER MOTOR
STARTER RELAY
BLK
BRN
A/T
M/T
BRN/YEL
BRN/YEL OR BLK
PARK/NEUTRAL POSITION SWITCH
TO POWERTRAIN CONTROL MODULE
YEL
IGNITION SWITCH
START
RUN
ACC
OFF
FUSE LINK
DK BLU
GENERATOR
DK GRN
TO ENGINE CONTROL MODULE
BATTERY
HOT AT ALL TIMES
FUSE LINK
GRY
A/C CLUTCH RELAY
DK BLU/BLK
A/C COMPRESSOR CLUTCH
EX. 2.5L
2.5L
DK BLU/ORG
COOLING FAN RELAY
LT GRN
COOLING FAN MOTOR
DK BLU/PNK
TO POWERTRAIN CONTROL MODULE
88476W17
HOT IN RUN
FUSE 4 10A
WHT
A/C LOW PRESSURE SWITCH
ELECTRONIC CYCLING CLUTCH SWITCH
TO INTERIOR LIGHTS SYSTEM
ORG
HEATER-A/C CONTROL ASSEMBLY
DEFROST SWITCH
A/C SWITCH
DK BLU/YEL
M1
M2
H
L
OFF
HOT IN RUN
FUSE 3 30A
BLOWER MOTOR
BLK/TAN
BLOWER MOTOR RESISTOR BLOCK
LT BLU/BLK
LT GRN/YEL
TAN/ORG

Fig. 83 Chassis wiring—1989–90 Dakotas

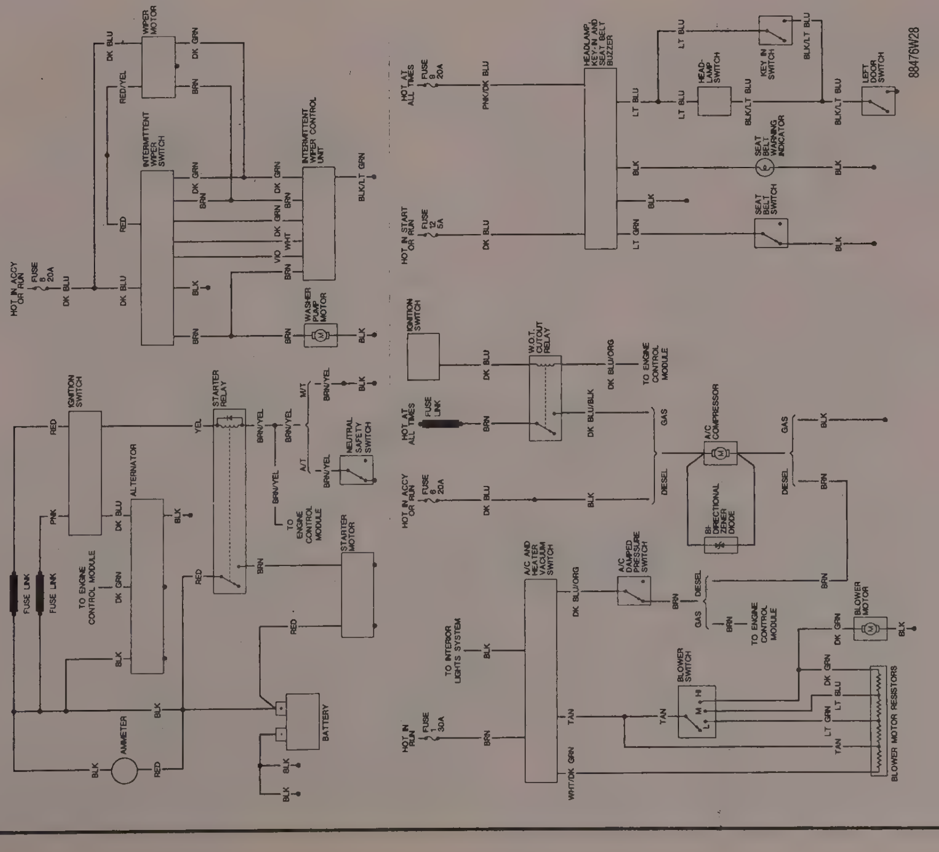

HOT IN ACCY OR RUN
FUSE 5 20A
WIPER MOTOR
INTERMITTENT WIPER SWITCH
INTERMITTENT WIPER CONTROL UNIT
WASHER PUMP MOTOR
IGNITION SWITCH
STARTER RELAY
ALTERNATOR
TO ENGINE CONTROL MODULE
FUSE LINK
AMMETER
BATTERY
STARTER MOTOR
NEUTRAL SAFETY SWITCH
M/T
A/T
HOT AT ALL TIMES
FUSE 9 20A
HOT IN START OR RUN
FUSE 12 5A
HEADLAMP, KEY-IN AND SEAT BELT BUZZER
HEAD-LAMP SWITCH
KEY IN SWITCH
LEFT DOOR SWITCH
SEAT BELT WARNING INDICATOR
SEAT BELT SWITCH
W.O.T. CUTOUT RELAY
A/C COMPRESSOR
BI-DIRECTIONAL ZENER DIODE
GAS
DIESEL
A/C AND HEATER VACUUM SWITCH
A/C DAMPED PRESSURE SWITCH
TO INTERIOR LIGHTS SYSTEM
HOT IN RUN
FUSE 1 30A
BLOWER SWITCH
BLOWER MOTOR
BLOWER MOTOR RESISTORS
88476W28

Fig. 85 Chassis wiring—1989 Ramcharger and Pick-up

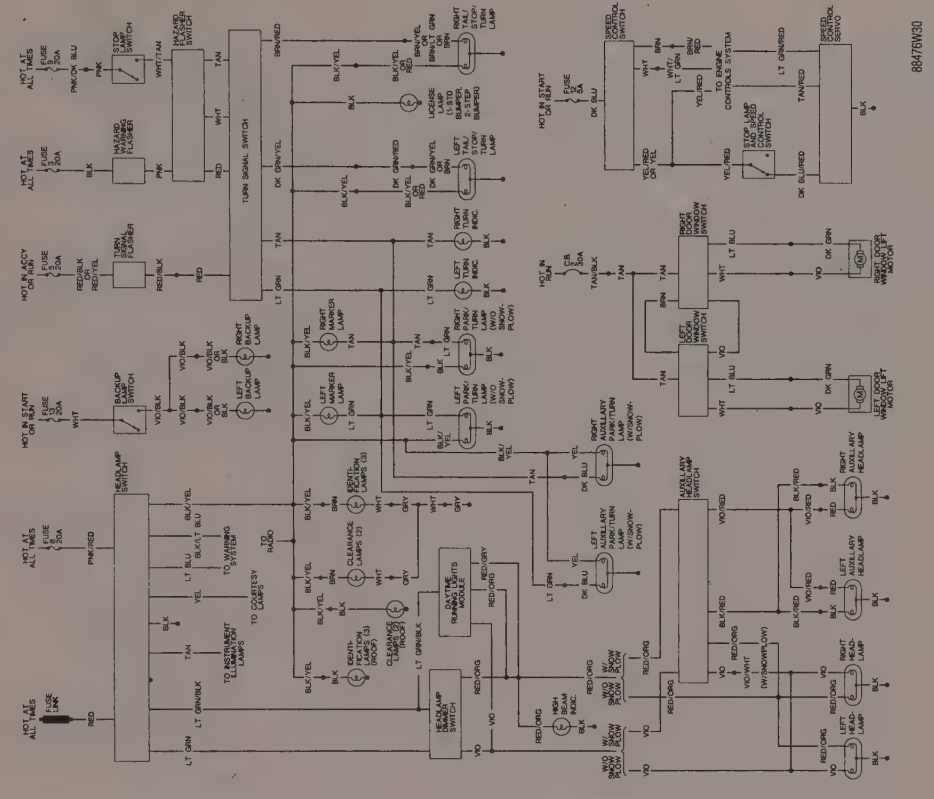

HOT AT ALL TIMES
FUSE LINK
HEADLAMP SWITCH
FUSE 8 20A
TO INSTRUMENT ILLUMINATION LAMPS
TO COURTESY LAMPS
TO WARNING SYSTEM
TO RADIO
HOT IN START OR RUN
FUSE 13 20A
BACKUP LAMP SWITCH
LEFT BACKUP LAMP
RIGHT BACKUP LAMP
HOT IN ACCY OR RUN
FUSE 5 20A
TURN SIGNAL FLASHER
HAZARD WARNING FLASHER
FUSE 9 20A
STOP LAMP SWITCH
HAZARD FLASHER SWITCH
TURN SIGNAL SWITCH
HEADLAMP DIMMER SWITCH
DAYTIME RUNNING LIGHTS MODULE
HIGH BEAM INDIC.
IDENTI-FICATION LAMPS (3) (ROOF)
CLEARANCE LAMPS (2) (ROOF)
CLEARANCE LAMPS (2)
IDENTI-FICATION LAMPS (3)
LEFT MARKER LAMP
RIGHT MARKER LAMP
LEFT PARK/TURN LAMP (W/O SNOW-PLOW)
RIGHT PARK/TURN LAMP (W/O SNOW-PLOW)
LEFT TURN INDIC.
RIGHT TURN INDIC.
LEFT TAIL/STOP/TURN LAMP
LICENSE LAMP (1-STD BUMPER, 2-STEP BUMPER)
RIGHT TAIL/STOP/TURN LAMP
LEFT AUXILIARY PARK/TURN LAMP (W/SNOW-PLOW)
RIGHT AUXILIARY PARK/TURN LAMP (W/SNOW-PLOW)
W/ SNOW PLOW
W/O SNOW PLOW
AUXILIARY HEADLAMP SWITCH
LEFT HEAD-LAMP
RIGHT HEAD-LAMP
LEFT AUXILIARY HEADLAMP
RIGHT AUXILIARY HEADLAMP
HOT IN RUN
C.B. 30A
LEFT DOOR WINDOW SWITCH
RIGHT DOOR WINDOW SWITCH
LEFT DOOR WINDOW LIFT MOTOR
RIGHT DOOR WINDOW LIFT MOTOR
FUSE 12 5A
SPEED CONTROL SWITCH
TO ENGINE CONTROLS SYSTEM
STOP LAMP AND SPEED CONTROL SWITCH
SPEED CONTROL SERVO
88476W30

Fig. 86 Chassis wiring—1989–90 Ramchargers and Pick-ups (continued)

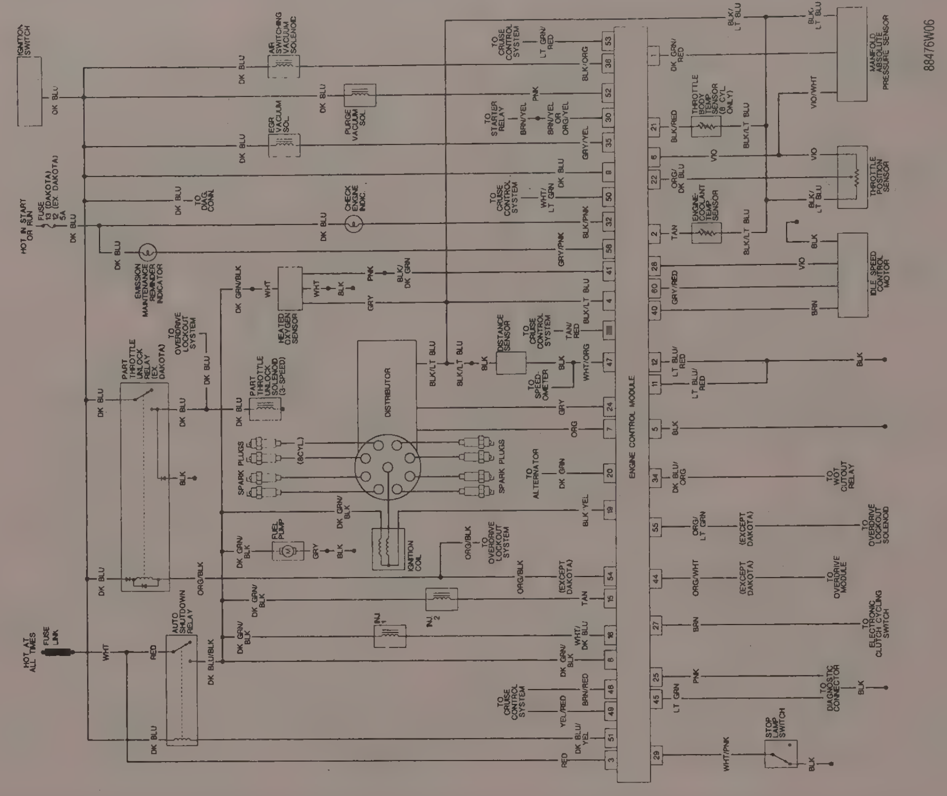

IGNITION SWITCH
HOT IN START OR RUN
FUSE 13 (DAKOTA) 12 (EX DAKOTA) 5A
HOT AT ALL TIMES
FUSE LINK
AIR SWITCHING VACUUM SOLENOID
EGR VACUUM SOL.
PURGE VACUUM SOL.
TO DIAG. CONN.
CHECK ENGINE INDIC.
EMISSION MAINTENANCE REMINDER INDICATOR
PART THROTTLE UNLOCK RELAY (EX DAKOTA)
TO OVERDRIVE LOCKOUT SYSTEM
HEATED OXYGEN SENSOR
PART THROTTLE UNLOCK SOLENOID (3 SPEED)
DISTRIBUTOR
SPARK PLUGS
(8CYL.)
FUEL PUMP
IGNITION COIL
INJ. 1
INJ. 2
AUTO SHUTDOWN RELAY
TO CRUISE CONTROL SYSTEM
TO STARTER RELAY
DISTANCE SENSOR
TO SPEEDOMETER
TO ALTERNATOR
ENGINE CONTROL MODULE
THROTTLE BODY TEMP SENSOR (8 CYL ONLY)
ENGINE COOLANT TEMP SENSOR
MANIFOLD ABSOLUTE PRESSURE SENSOR
THROTTLE POSITION SENSOR
IDLE SPEED CONTROL MOTOR
TO WOT CUTOUT RELAY
TO OVERDRIVE LOCKOUT SOLENOID
TO OVERDRIVE MODULE
TO ELECTRONIC CLUTCH CYCLING SWITCH
TO DIAGNOSTIC CONNECTOR
STOP LAMP SWITCH
(EXCEPT DAKOTA)
88476W06

Fig. 88 Engine wiring—1990–91 3.9L, 5.2L and 5.9L gasoline engines (all models)

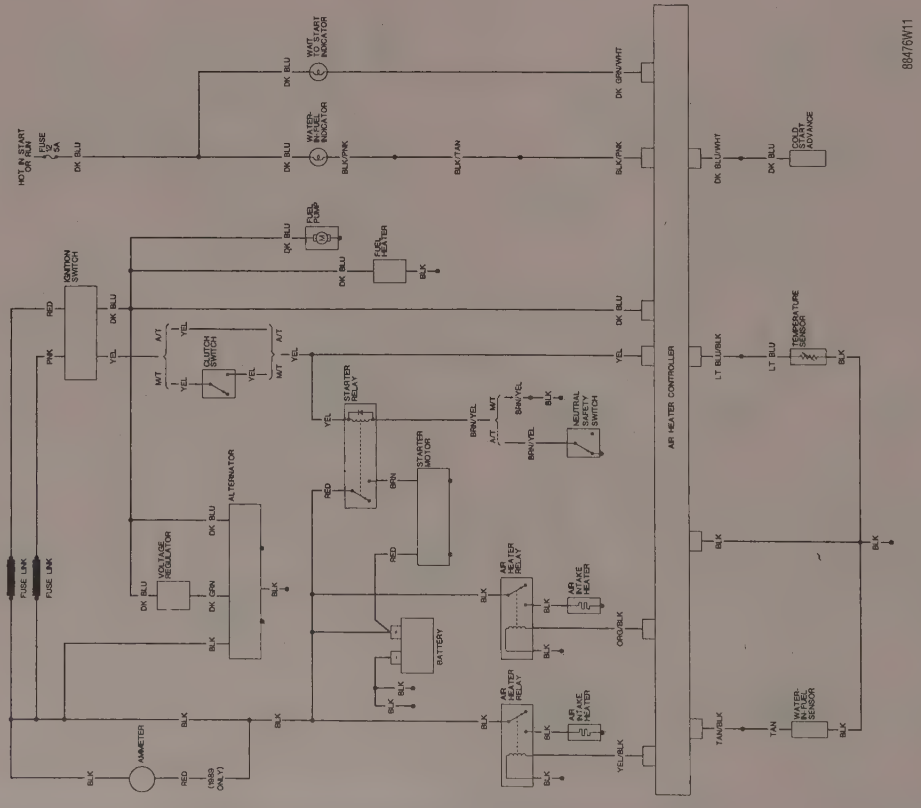

HOT IN START OR RUN
FUSE 12 5A
WAIT TO START INDICATOR
WATER-IN-FUEL INDICATOR
COLD START ADVANCE
FUEL PUMP
FUEL HEATER
IGNITION SWITCH
CLUTCH SWITCH
STARTER RELAY
NEUTRAL SAFETY SWITCH
STARTER MOTOR
ALTERNATOR
VOLTAGE REGULATOR
FUSE LINK
FUSE LINK
AIR HEATER RELAY
AIR INTAKE HEATER
BATTERY
AMMETER
(1989 ONLY)
AIR HEATER CONTROLLER
TEMPERATURE SENSOR
WATER-IN-FUEL SENSOR
88476W11

Fig. 87 Engine wiring—1989–91 5.9L diesel Pick-ups

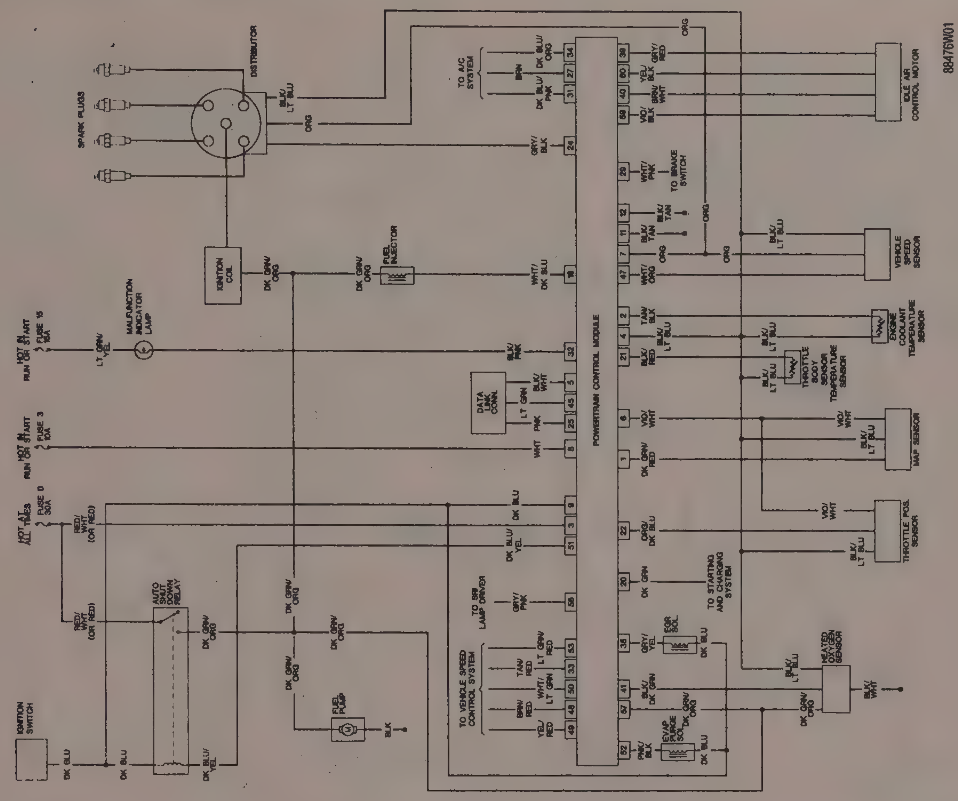

SPARK PLUGS
DISTRIBUTOR
IGNITION COIL
FUEL INJECTOR
MALFUNCTION INDICATOR LAMP
HOT IN RUN OR START FUSE 15 10A
HOT IN RUN OR START FUSE 3 10A
HOT AT ALL TIMES FUSE D 30A
AUTO SHUT DOWN RELAY
IGNITION SWITCH
FUEL PUMP
DATA LINK CONN.
POWERTRAIN CONTROL MODULE
TO A/C SYSTEM
IDLE AIR CONTROL MOTOR
TO BRAKE SWITCH
VEHICLE SPEED SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
THROTTLE BODY SENSOR TEMPERATURE SENSOR
MAP SENSOR
THROTTLE POS. SENSOR
TO STARTING AND CHARGING SYSTEM
HEATED OXYGEN SENSOR
EGR SOL
EVAP PURGE SOL
TO VEHICLE SPEED CONTROL SYSTEM
TO SRI LAMP DRIVER
88476W01

Fig. 90 Engine wiring—1990–93 2.5L Dakotas

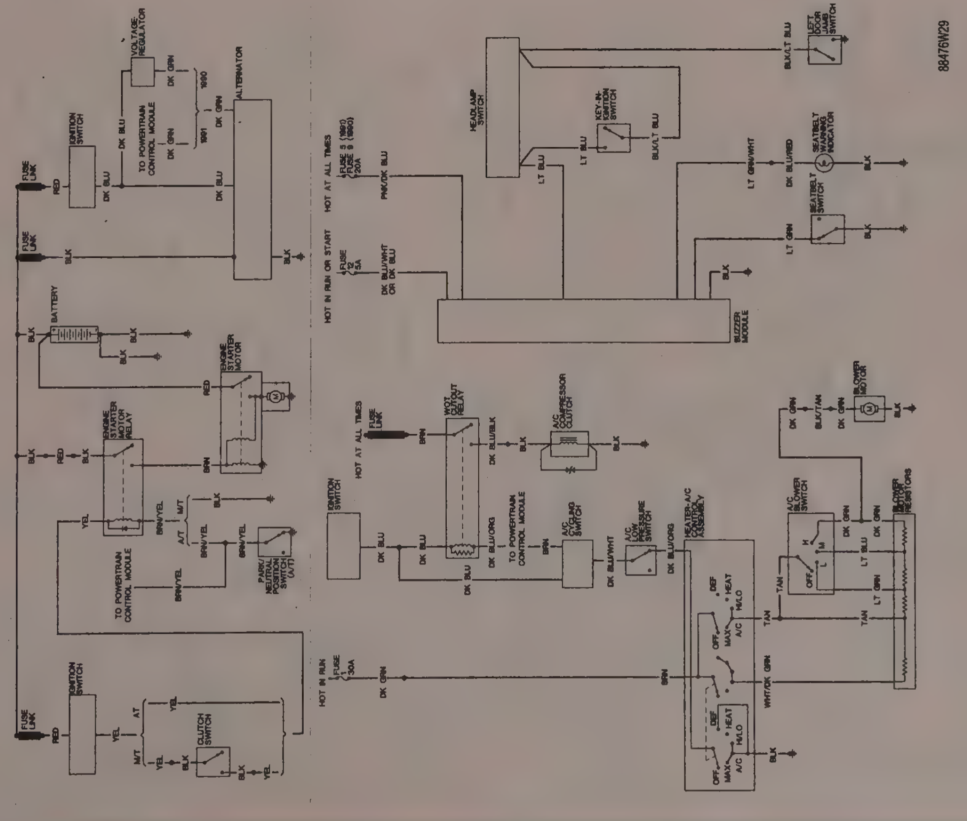

FUSE LINK
IGNITION SWITCH
VOLTAGE REGULATOR
TO POWERTRAIN CONTROL MODULE
1990
1991
ALTERNATOR
BATTERY
ENGINE STARTER MOTOR
ENGINE STARTER MOTOR RELAY
PARK/NEUTRAL POSITION SWITCH (A/T)
CLUTCH SWITCH
HOT IN RUN OR START FUSE 12 5A
HOT AT ALL TIMES FUSE 5 (1991) FUSE 9 (1990) 20A
HEADLAMP SWITCH
KEY-IN-IGNITION SWITCH
LEFT DOOR JAMB SWITCH
SEATBELT WARNING INDICATOR
SEATBELT SWITCH
BUZZER MODULE
HOT AT ALL TIMES
WOT CUTOUT RELAY
A/C COMPRESSOR CLUTCH
A/C CYCLING SWITCH
A/C LOW PRESSURE SWITCH
HEATER-A/C CONTROL ASSEMBLY
A/C BLOWER SWITCH
BLOWER MOTOR
BLOWER MOTOR RESISTORS
HOT IN RUN FUSE 1 30A
88476W29

Fig. 89 Chassis wiring—1990–91 Ramchargers and Pick-ups

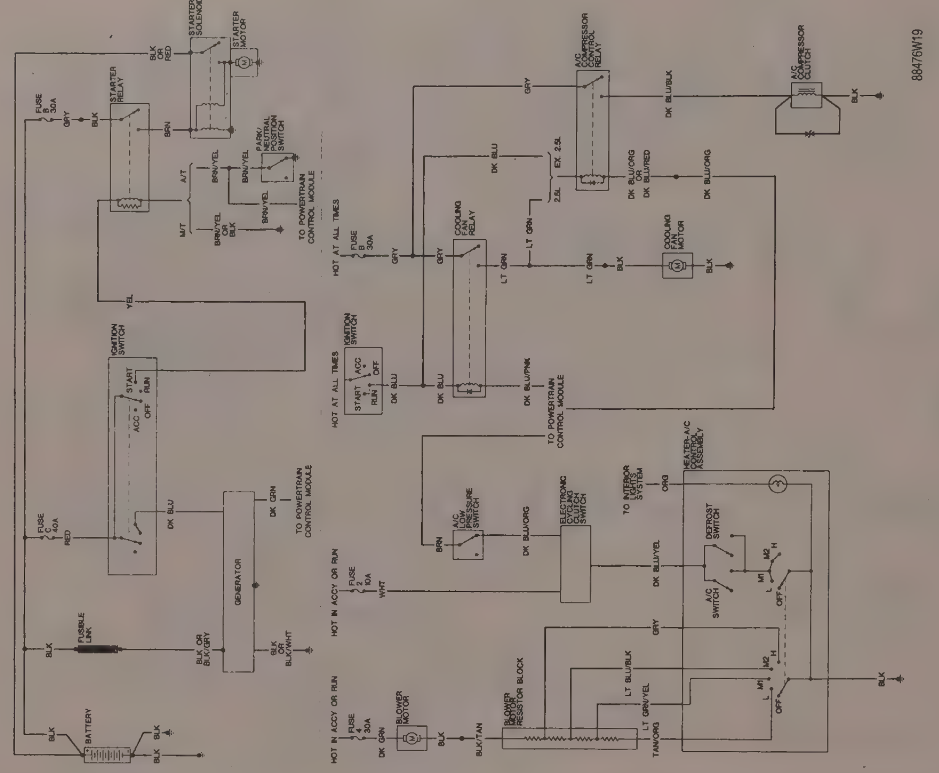

BATTERY
FUSIBLE LINK
GENERATOR
IGNITION SWITCH
STARTER RELAY
STARTER SOLENOID
STARTER MOTOR
PARK/NEUTRAL POSITION SWITCH
TO POWERTRAIN CONTROL MODULE
HOT AT ALL TIMES
HOT IN ACCY OR RUN
FUSE B 30A
FUSE C 40A
FUSE 2 10A
FUSE 4 30A
COOLING FAN RELAY
COOLING FAN MOTOR
A/C COMPRESSOR CONTROL RELAY
A/C COMPRESSOR CLUTCH
A/C LOW PRESSURE SWITCH
ELECTRONIC CYCLING CLUTCH SWITCH
BLOWER MOTOR
BLOWER MOTOR RESISTOR BLOCK
HEATER-A/C CONTROL ASSEMBLY
DEFROST SWITCH
A/C SWITCH
TO INTERIOR LIGHTS SYSTEM
88476W19

Fig. 92 Chassis wiring—1991 Dakota

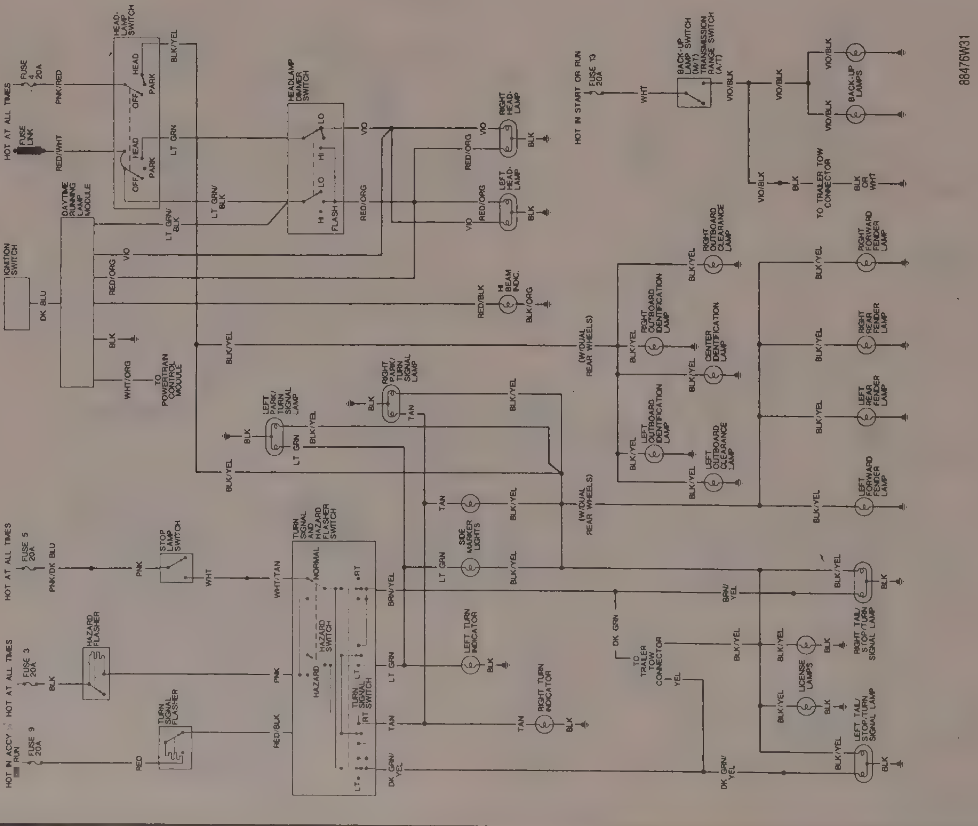

HOT AT ALL TIMES
HOT IN ACCY OR RUN
HOT IN START OR RUN
FUSE 3 20A
FUSE 4 20A
FUSE 5 20A
FUSE 9 20A
FUSE 13 20A
FUSE LINK
HEAD-LAMP SWITCH
HEADLAMP DIMMER SWITCH
DAYTIME RUNNING LAMP MODULE
IGNITION SWITCH
TO POWERTRAIN CONTROL MODULE
RIGHT HEAD-LAMP
LEFT HEAD-LAMP
HI BEAM INDIC.
HAZARD FLASHER
TURN SIGNAL FLASHER
STOP LAMP SWITCH
TURN SIGNAL AND HAZARD FLASHER SWITCH
LEFT PARK/TURN SIGNAL LAMP
RIGHT PARK/TURN SIGNAL LAMP
SIDE MARKER LIGHTS
LEFT TURN INDICATOR
RIGHT TURN INDICATOR
TO TRAILER TOW CONNECTOR
LICENSE LAMPS
LEFT TAIL/STOP/TURN SIGNAL LAMP
RIGHT TAIL/STOP/TURN SIGNAL LAMP
BACK-UP LAMP SWITCH (M/T) TRANSMISSION RANGE SWITCH (A/T)
BACK-UP LAMPS
RIGHT OUTBOARD CLEARANCE LAMP
RIGHT OUTBOARD IDENTIFICATION LAMP
CENTER IDENTIFICATION LAMP
LEFT OUTBOARD IDENTIFICATION LAMP
LEFT OUTBOARD CLEARANCE LAMP
RIGHT FORWARD FENDER LAMP
RIGHT REAR FENDER LAMP
LEFT REAR FENDER LAMP
LEFT FORWARD FENDER LAMP
(W/DUAL REAR WHEELS)
88476W31

Fig. 91 Chassis wiring—1991 Ramcharger and Pick-up (continued)

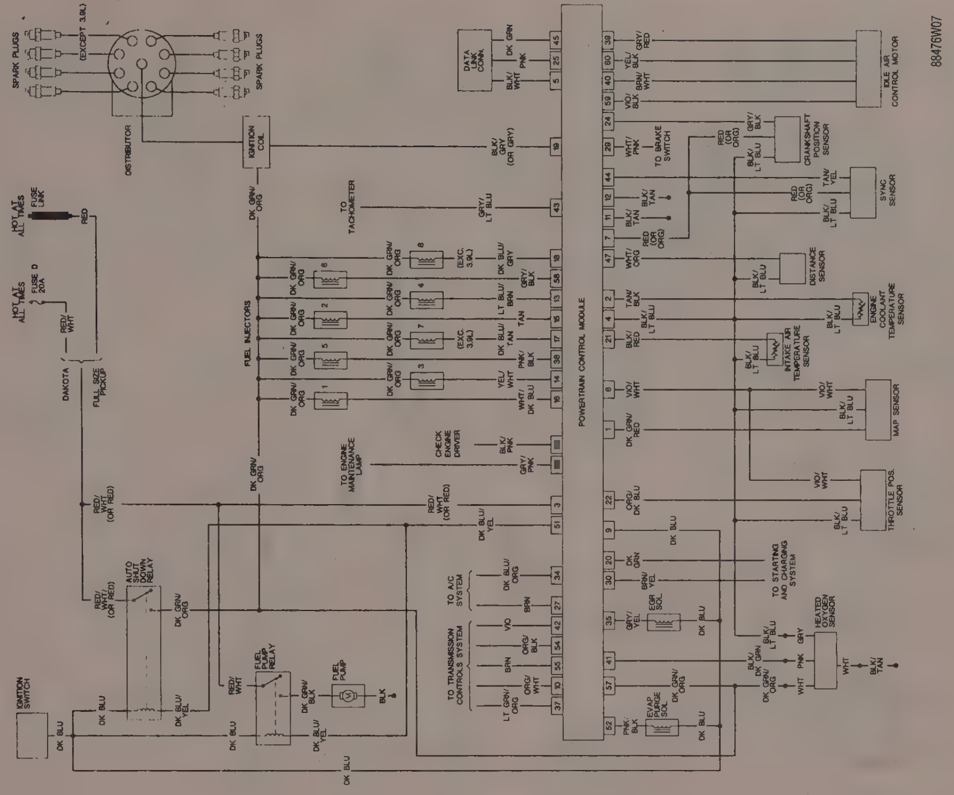

SPARK PLUGS
(EXCEPT 3.9L)
DISTRIBUTOR
IGNITION COIL
HOT AT ALL TIMES
FUSE LINK
RED
HOT AT ALL TIMES
FUSE D 20A
RED/WHT
DAKOTA
FULL SIZE PICKUP
FUEL INJECTORS
DK GRN/ORG
TO TACHOMETER
GRY/LT BLU
BLK/GRY (OR GRY)
DATA LINK CONN.
TO ENGINE MAINTENANCE LAMP
CHECK ENGINE DRIVER
RED/WHT (OR RED)
AUTO SHUT DOWN RELAY
IGNITION SWITCH
DK BLU
FUEL PUMP RELAY
FUEL PUMP
BLK
TO A/C SYSTEM
TO TRANSMISSION CONTROLS SYSTEM
POWERTRAIN CONTROL MODULE
EGR SOL
EVAP PURGE SOL
TO BRAKE SWITCH
CRANKSHAFT POSITION SENSOR
SYNC SENSOR
DISTANCE SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
MAP SENSOR
THROTTLE POS. SENSOR
TO STARTING AND CHARGING SYSTEM
HEATED OXYGEN SENSOR
IDLE AIR CONTROL MOTOR
88476W07

Fig. 94 Engine wiring—1992 3.9L/5.2L Dakota, Ramcharger and Pick-up

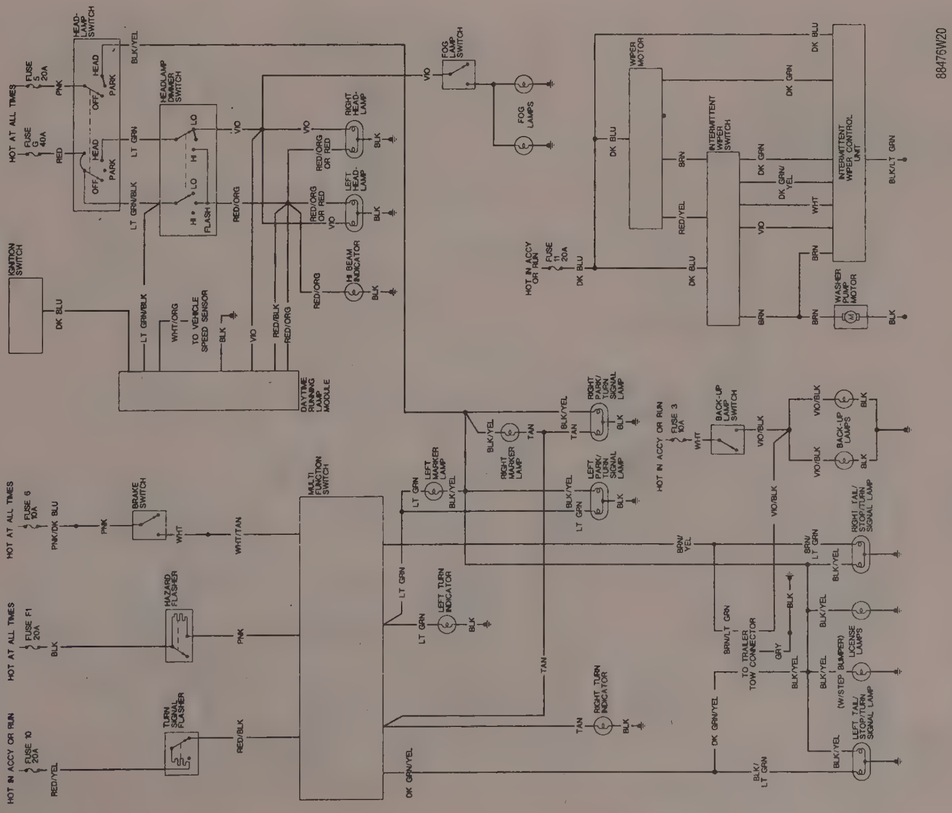

HOT AT ALL TIMES
FUSE G 40A
FUSE 5 20A
HEADLAMP SWITCH
HEADLAMP DIMMER SWITCH
IGNITION SWITCH
DK BLU
LT GRN/BLK
WHT/ORG
TO VEHICLE SPEED SENSOR
DAYTIME RUNNING LAMP MODULE
RIGHT HEADLAMP
LEFT HEADLAMP
HI BEAM INDICATOR
FOG LAMP SWITCH
FOG LAMPS
HOT IN ACCY OR RUN
FUSE 11 20A
WIPER MOTOR
INTERMITTENT WIPER SWITCH
INTERMITTENT WIPER CONTROL UNIT
WASHER PUMP MOTOR
HOT AT ALL TIMES
FUSE 6 10A
BRAKE SWITCH
FUSE F1 20A
HAZARD FLASHER
HOT IN ACCY OR RUN
FUSE 10 20A
TURN SIGNAL FLASHER
MULTI FUNCTION SWITCH
LEFT MARKER LAMP
RIGHT MARKER LAMP
LEFT TURN INDICATOR
RIGHT TURN INDICATOR
RIGHT PARK/TURN SIGNAL LAMP
LEFT PARK/TURN SIGNAL LAMP
HOT IN ACCY OR RUN
FUSE 3 10A
BACK-UP LAMP SWITCH
BACK-UP LAMPS
TO TRAILER TOW CONNECTOR
RIGHT TAIL/STOP/TURN SIGNAL LAMP
LICENSE LAMPS
(W/STEP BUMPER)
LEFT TAIL/STOP/TURN SIGNAL LAMP
88476W20

Fig. 93 Chassis wiring—1991 Dakota (continued)

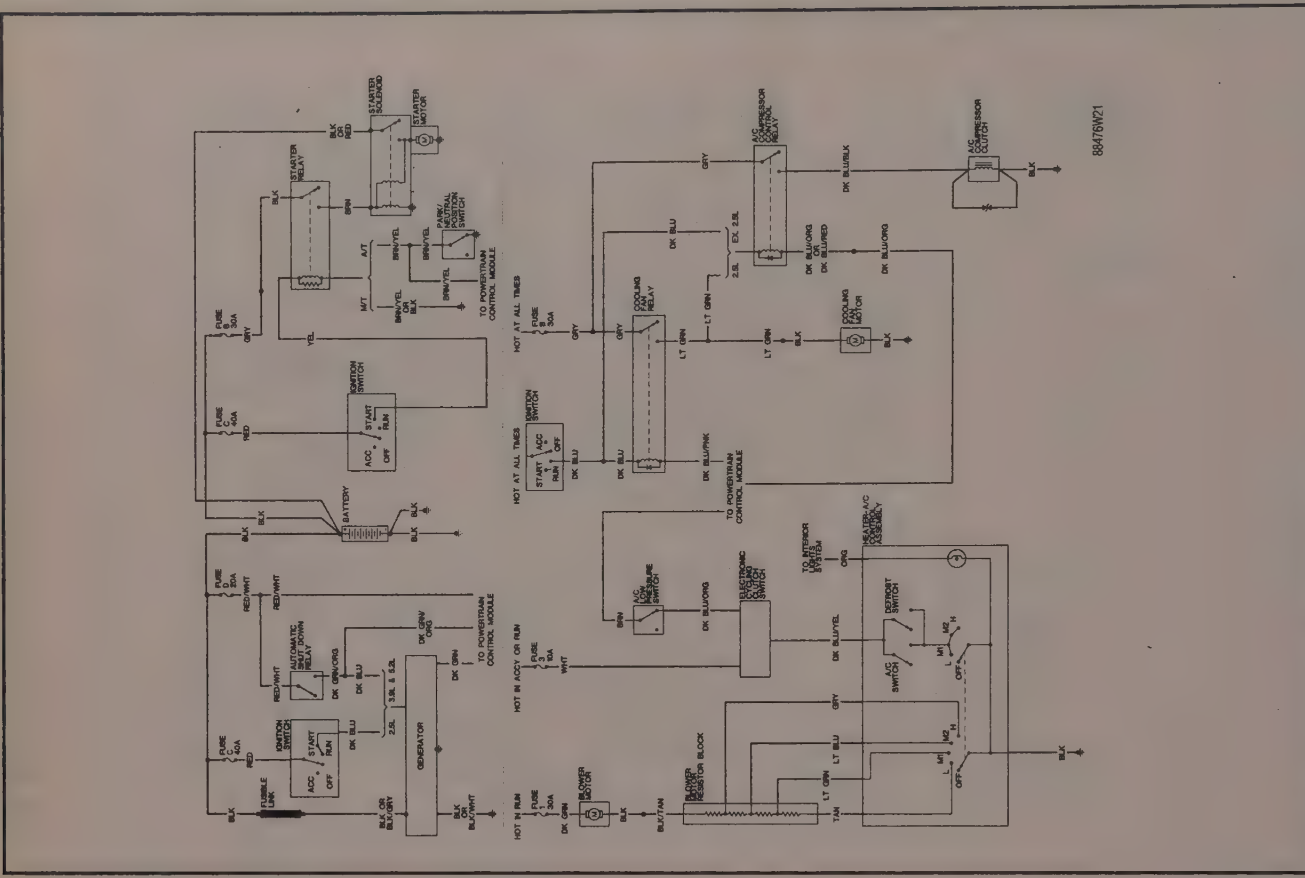

STARTER SOLENOID
STARTER MOTOR
STARTER RELAY
PARK/NEUTRAL POSITION SWITCH
TO POWERTRAIN CONTROL MODULE
FUSE B 30A
FUSE C 40A
FUSE D 20A
IGNITION SWITCH
BATTERY
AUTOMATIC SHUT DOWN RELAY
GENERATOR
FUSIBLE LINK
A/C COMPRESSOR CONTROL RELAY
A/C COMPRESSOR CLUTCH
COOLING FAN RELAY
COOLING FAN MOTOR
HOT AT ALL TIMES
HOT IN ACCY OR RUN
HOT IN RUN
BLOWER MOTOR
BLOWER MOTOR RESISTOR BLOCK
A/C LOW PRESSURE SWITCH
ELECTRONIC CYCLING CLUTCH SWITCH
TO INTERIOR LIGHTS SYSTEM
HEATER-A/C CONTROL ASSEMBLY
DEFROST SWITCH
A/C SWITCH
8847GW21

Fig. 96 Chassis wiring—1992–93 Dakotas

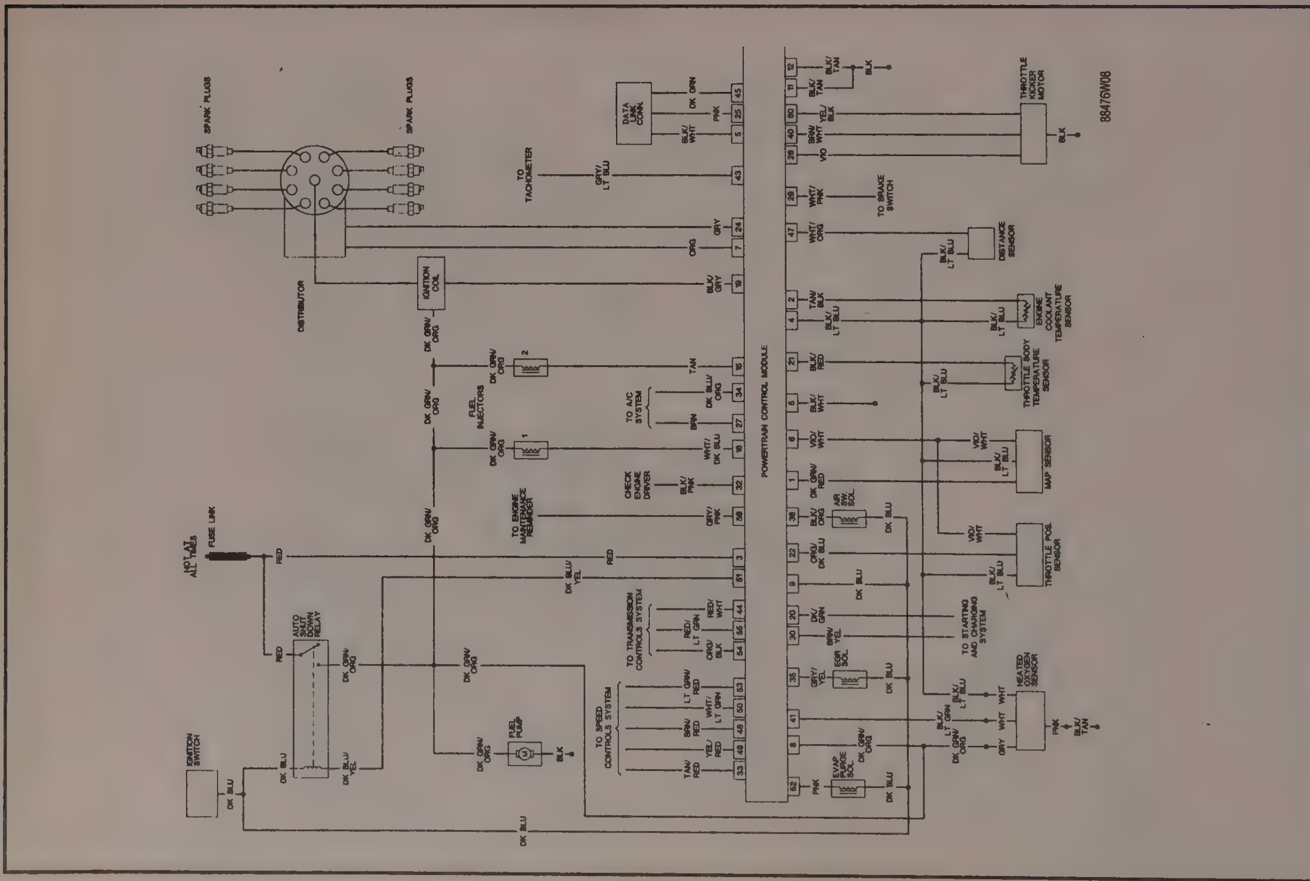

SPARK PLUGS
DISTRIBUTOR
IGNITION COIL
TO TACHOMETER
DATA LINK CONN.
POWERTRAIN CONTROL MODULE
FUEL INJECTORS
TO A/C SYSTEM
CHECK ENGINE DRIVER
TO ENGINE MAINTENANCE REMINDER
HOT AT ALL TIMES
FUSE LINK
AUTO SHUT DOWN RELAY
IGNITION SWITCH
FUEL PUMP
TO TRANSMISSION CONTROLS SYSTEM
TO SPEED CONTROLS SYSTEM
THROTTLE KICKER MOTOR
TO BRAKE SWITCH
DISTANCE SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
THROTTLE BODY TEMPERATURE SENSOR
MAP SENSOR
THROTTLE POS. SENSOR
AIR SW SOL
TO STARTING AND CHARGING SYSTEM
EGR SOL
EVAP PURGE SOL
HEATED OXYGEN SENSOR
8847GW08

Fig. 95 Engine wiring—1992 5.9L gasoline engine Ramcharger and Pick-up

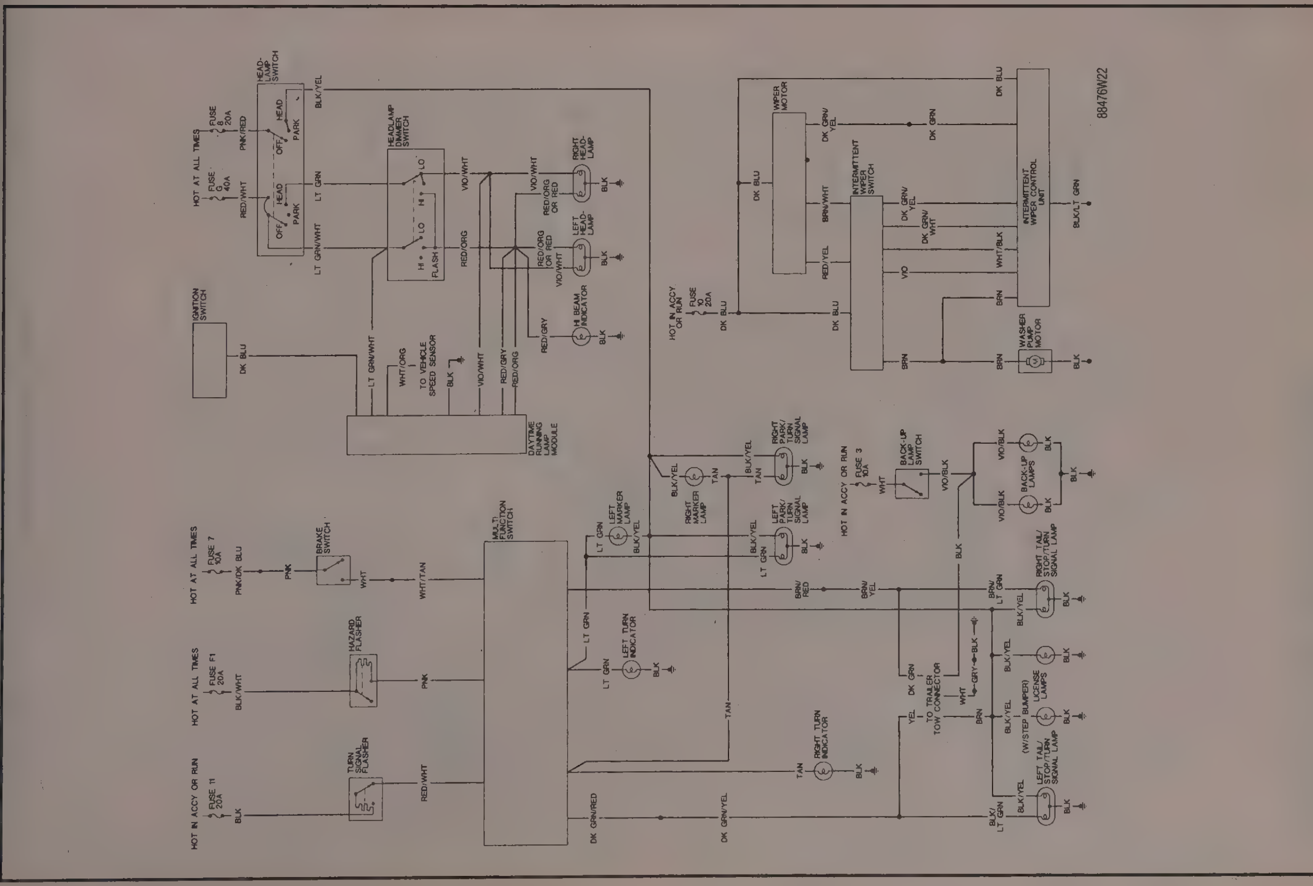

HOT IN ACCY OR RUN
FUSE 11 20A
TURN SIGNAL FLASHER
HOT AT ALL TIMES
FUSE F1 20A
HAZARD FLASHER
FUSE 7 10A
BRAKE SWITCH
MULTI-FUNCTION SWITCH
IGNITION SWITCH
FUSE G 40A
FUSE 8 20A
HEADLAMP SWITCH
HEAD
PARK
OFF
HEADLAMP DIMMER SWITCH
LO
HI
FLASH
RIGHT HEADLAMP
LEFT HEADLAMP
HI BEAM INDICATOR
DAYTIME RUNNING LAMP MODULE
TO VEHICLE SPEED SENSOR
LEFT TURN INDICATOR
RIGHT TURN INDICATOR
LEFT MARKER LAMP
RIGHT MARKER LAMP
LEFT PARK/TURN SIGNAL LAMP
RIGHT PARK/TURN SIGNAL LAMP
FUSE 3 10A
BACK-UP LAMP SWITCH
BACK-UP LAMPS
TO TRAILER TOW CONNECTOR
RIGHT TAIL/STOP/TURN SIGNAL LAMP
LEFT TAIL/STOP/TURN SIGNAL LAMP
LICENSE LAMPS
(W/STEP BUMPER)
FUSE 10 20A
WIPER MOTOR
INTERMITTENT WIPER SWITCH
INTERMITTENT WIPER CONTROL UNIT
WASHER PUMP MOTOR
88476W22

Fig. 97 Chassis wiring—1992–93 Dakotas (continued)

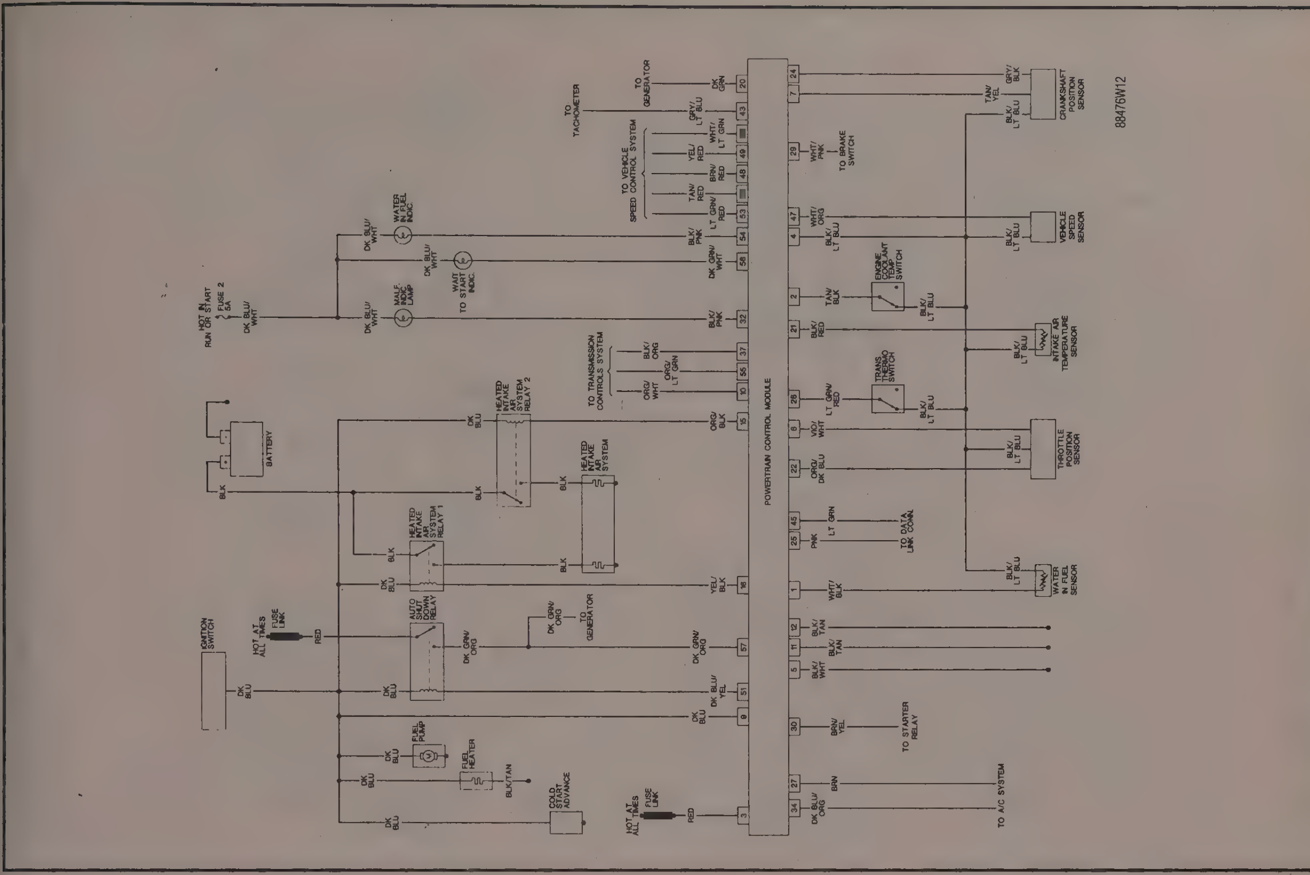

IGNITION SWITCH
HOT IN RUN OR START
FUSE 2 5A
BATTERY
HOT AT ALL TIMES
FUSE LINK
FUEL PUMP
FUEL HEATER
COLD START ADVANCE
AUTO SHUT DOWN RELAY
HEATED INTAKE AIR SYSTEM RELAY 1
HEATED INTAKE AIR SYSTEM RELAY 2
HEATED INTAKE AIR SYSTEM
TO GENERATOR
MALF INDIC LAMP
WAIT TO START INDIC
WATER IN FUEL INDIC
TO TRANSMISSION CONTROLS SYSTEM
TO VEHICLE SPEED CONTROL SYSTEM
TO TACHOMETER
POWERTRAIN CONTROL MODULE
TO A/C SYSTEM
TO STARTER RELAY
TO DATA LINK CONN.
WATER IN FUEL SENSOR
THROTTLE POSITION SENSOR
TRANS THERMO SWITCH
INTAKE AIR TEMPERATURE SENSOR
ENGINE COOLANT TEMP SWITCH
VEHICLE SPEED SENSOR
TO BRAKE SWITCH
CRANKSHAFT POSITION SENSOR
88476W12

Fig. 98 Engine wiring—1992–93 5.9L diesel Pick-ups

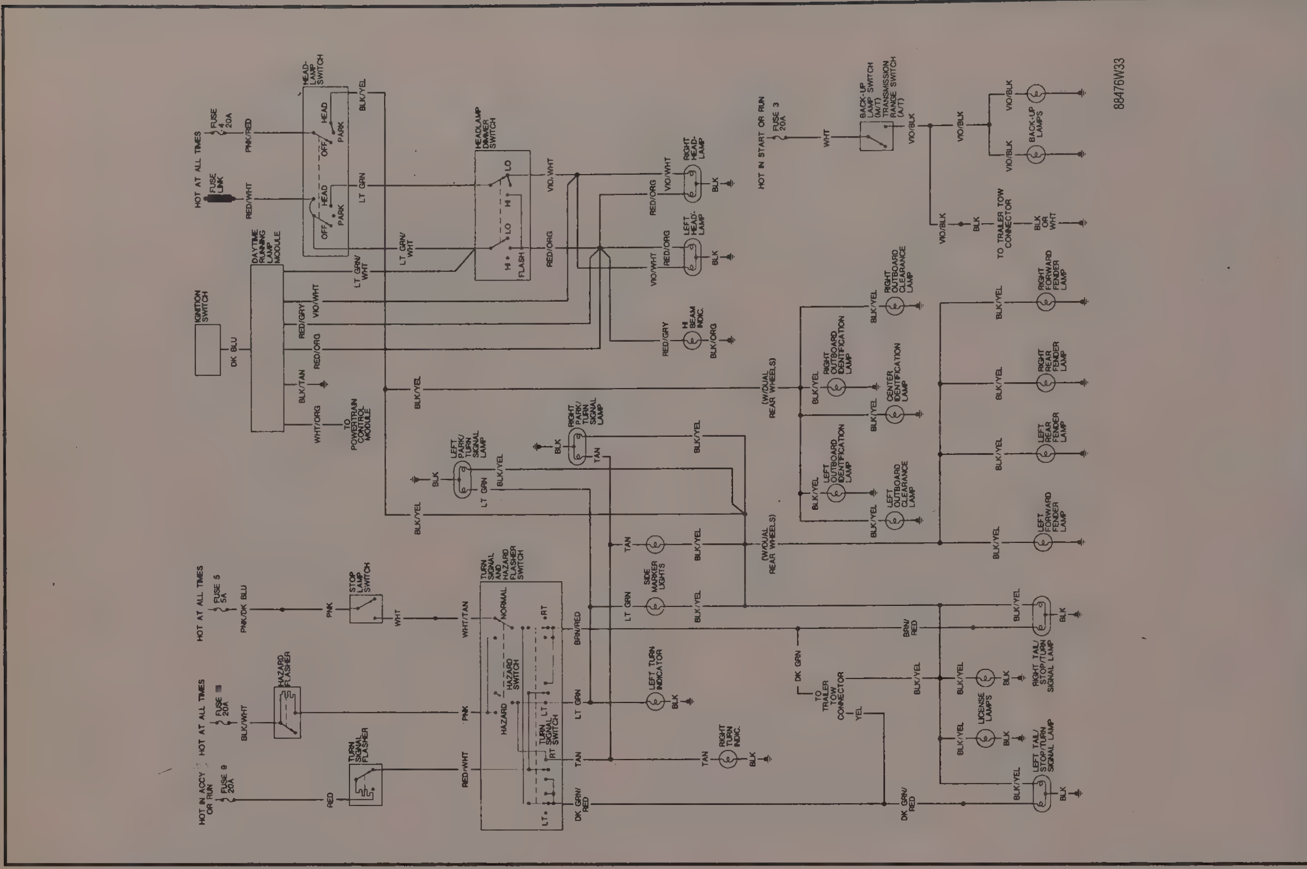

HOT AT ALL TIMES
FUSE LINK
FUSE 4 20A
HEAD-LAMP SWITCH
IGNITION SWITCH
DAYTIME RUNNING LAMP MODULE
HEADLAMP DIMMER SWITCH
RIGHT HEAD-LAMP
LEFT HEAD-LAMP
HI BEAM INDIC.
HOT IN START OR RUN
FUSE 3 20A
BACK-UP LAMP SWITCH (M/T) TRANSMISSION RANGE SWITCH (A/T)
BACK-UP LAMPS
TO TRAILER TOW CONNECTOR
TO POWERTRAIN CONTROL MODULE
LEFT PARK/TURN SIGNAL LAMP
RIGHT PARK/TURN SIGNAL LAMP
(W/DUAL REAR WHEELS)
RIGHT OUTBOARD CLEARANCE LAMP
RIGHT OUTBOARD IDENTIFICATION LAMP
CENTER IDENTIFICATION LAMP
LEFT OUTBOARD IDENTIFICATION LAMP
LEFT OUTBOARD CLEARANCE LAMP
RIGHT FORWARD FENDER LAMP
RIGHT REAR FENDER LAMP
LEFT REAR FENDER LAMP
LEFT FORWARD FENDER LAMP
STOP LAMP SWITCH
FUSE 5 5A
HAZARD FLASHER
FUSE 18 20A
TURN SIGNAL FLASHER
HOT IN ACCY OR RUN
FUSE 9 20A
TURN SIGNAL AND HAZARD FLASHER SWITCH
NORMAL
HAZARD
HAZARD SWITCH
TURN SIGNAL LT/RT SWITCH
SIDE MARKER LIGHTS
LEFT TURN INDICATOR
RIGHT TURN INDIC.
TO TRAILER TOW CONNECTOR
LICENSE LAMPS
RIGHT TAIL/STOP/TURN SIGNAL LAMP
LEFT TAIL/STOP/TURN SIGNAL LAMP
88476W33

Fig. 100 Chassis wiring—1992–93 Ramchargers and Pick-ups (continued)

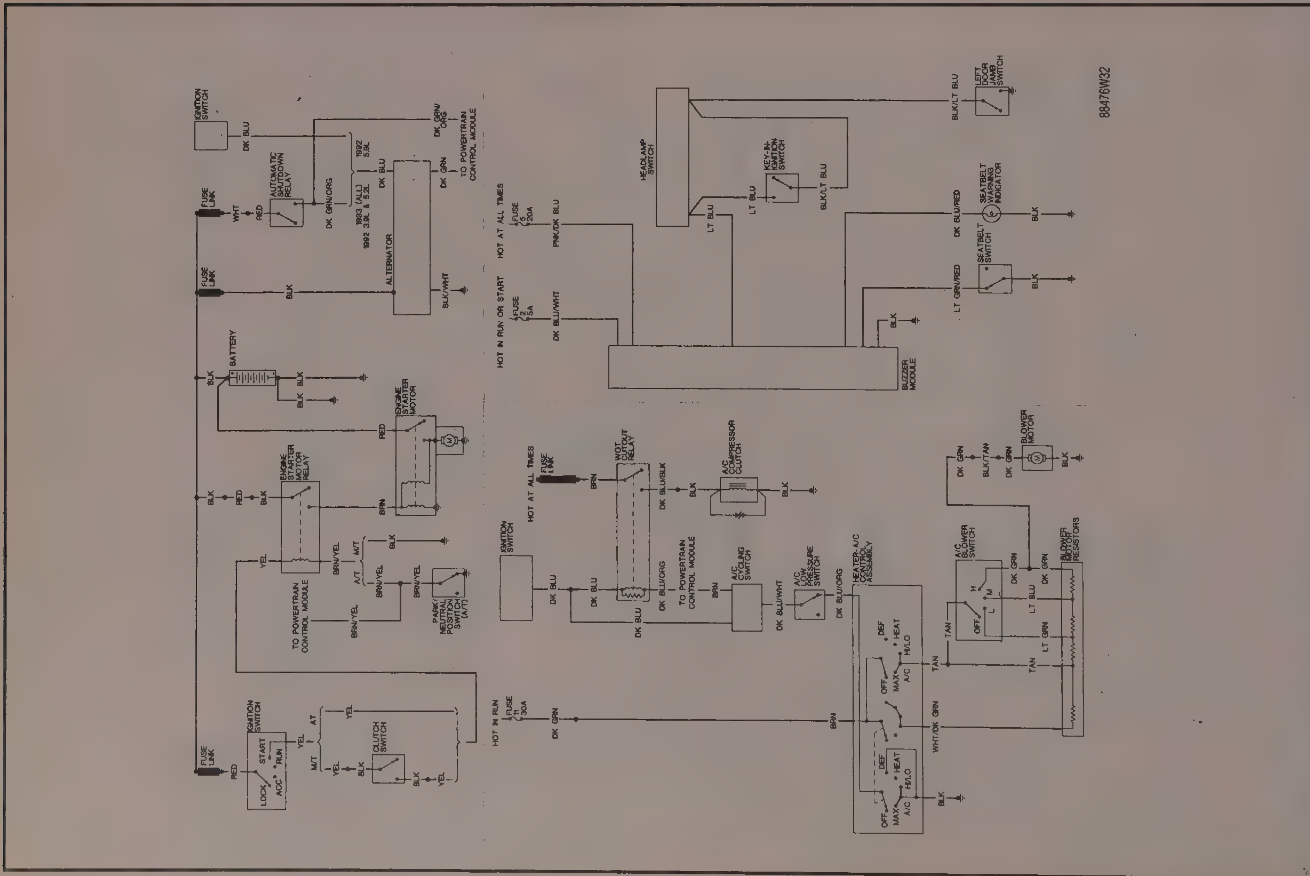

IGNITION SWITCH
FUSE LINK
AUTOMATIC SHUTDOWN RELAY
1993 (ALL) 1992 3.9L & 5.2L
1992 5.9L
ALTERNATOR
TO POWERTRAIN CONTROL MODULE
BATTERY
ENGINE STARTER MOTOR
ENGINE STARTER MOTOR RELAY
TO POWERTRAIN CONTROL MODULE
PARK/NEUTRAL POSITION SWITCH (A/T)
LOCK
ACC
START
RUN
CLUTCH SWITCH
HOT AT ALL TIMES
FUSE 5 20A
HOT IN RUN OR START
FUSE 2 5A
HEADLAMP SWITCH
KEY-IN-IGNITION SWITCH
LEFT DOOR JAMB SWITCH
SEATBELT WARNING INDICATOR
SEATBELT SWITCH
BUZZER MODULE
WOT CUTOUT RELAY
A/C COMPRESSOR CLUTCH
A/C CYCLING SWITCH
A/C LOW PRESSURE SWITCH
HEATER-A/C CONTROL ASSEMBLY
A/C BLOWER SWITCH
BLOWER MOTOR
BLOWER MOTOR RESISTORS
HOT IN RUN
FUSE 11 30A
88476W32

Fig. 99 Chassis wiring—1992–93 Ramchargers and Pick-ups

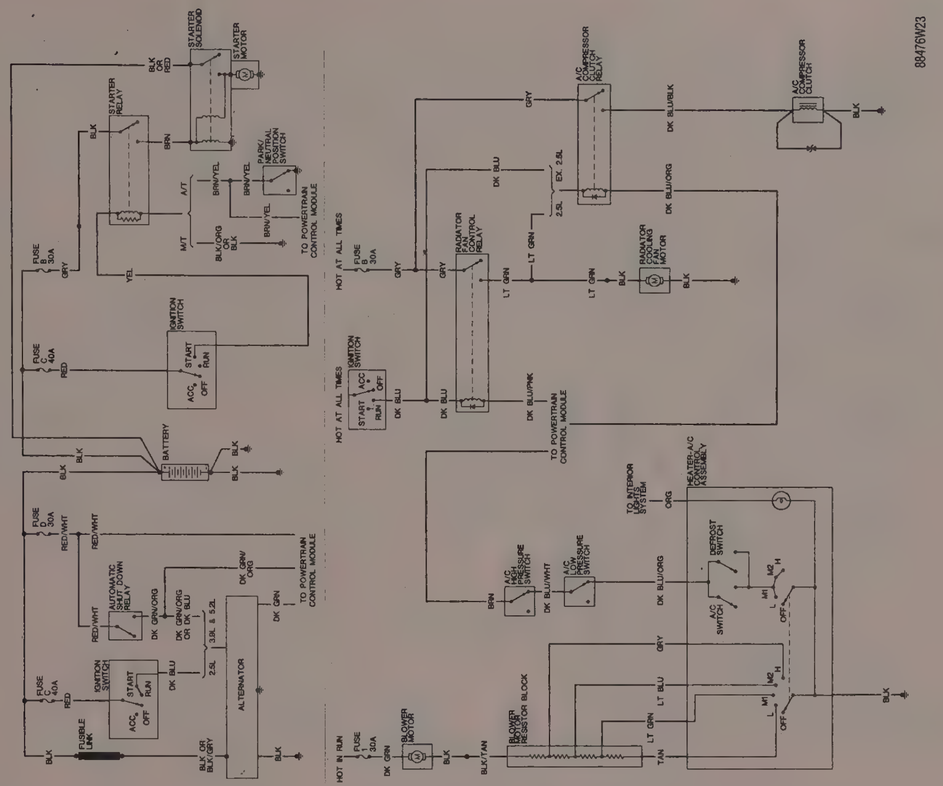

STARTER SOLENOID
STARTER MOTOR
STARTER RELAY
PARK/NEUTRAL POSITION SWITCH
TO POWERTRAIN CONTROL MODULE
FUSE B 30A
FUSE C 40A
IGNITION SWITCH
BATTERY
FUSE D 30A
AUTOMATIC SHUT DOWN RELAY
ALTERNATOR
FUSIBLE LINK
HOT AT ALL TIMES
HOT IN RUN
FUSE 1 30A
BLOWER MOTOR
BLOWER MOTOR RESISTOR BLOCK
RADIATOR FAN CONTROL RELAY
RADIATOR COOLING FAN MOTOR
A/C COMPRESSOR CLUTCH RELAY
A/C COMPRESSOR CLUTCH
A/C HIGH PRESSURE SWITCH
A/C LOW PRESSURE SWITCH
HEATER-A/C CONTROL ASSEMBLY
TO INTERIOR LIGHTS SYSTEM
DEFROST SWITCH
A/C SWITCH
88476W23

Fig. 102 Chassis wiring—1994 Dakota

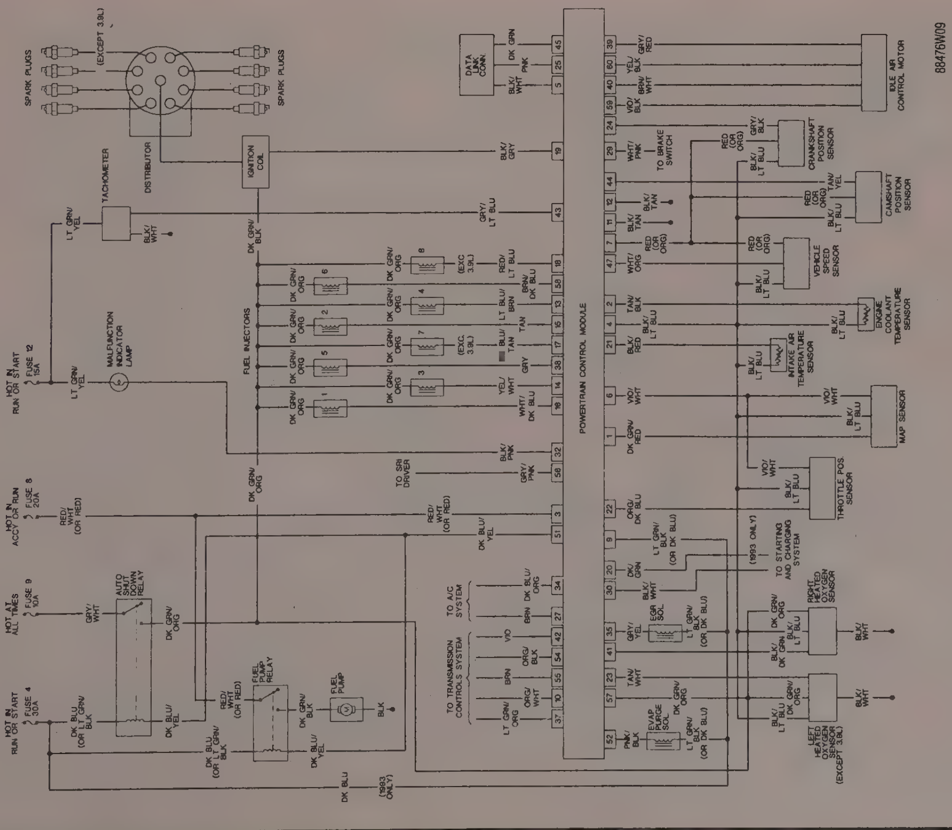

SPARK PLUGS
(EXCEPT 3.9L)
DISTRIBUTOR
TACHOMETER
IGNITION COIL
MALFUNCTION INDICATOR LAMP
FUEL INJECTORS
DATA LINK CONN
POWERTRAIN CONTROL MODULE
IDLE AIR CONTROL MOTOR
CRANKSHAFT POSITION SENSOR
CAMSHAFT POSITION SENSOR
VEHICLE SPEED SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
MAP SENSOR
THROTTLE POS. SENSOR
TO STARTING AND CHARGING SYSTEM
RIGHT HEATED OXYGEN SENSOR
LEFT HEATED OXYGEN SENSOR (EXCEPT 3.9L)
EGR SOL
EVAP PURGE SOL
TO TRANSMISSION CONTROLS SYSTEM
TO A/C SYSTEM
TO SRI DRIVER
TO BRAKE SWITCH
FUEL PUMP
FUEL PUMP RELAY
AUTO SHUT DOWN RELAY
HOT IN RUN OR START FUSE 4 30A
HOT AT ALL TIMES FUSE 9 10A
HOT IN ACCY OR RUN FUSE 8 20A
HOT IN RUN OR START FUSE 12 15A
88476W09

Fig. 101 Engine wiring—1993 3.9L/5.2L Dakota and Ramcharger; 1993–95 3.9L, 5.2L and 5.9L gasoline engine Pick-ups

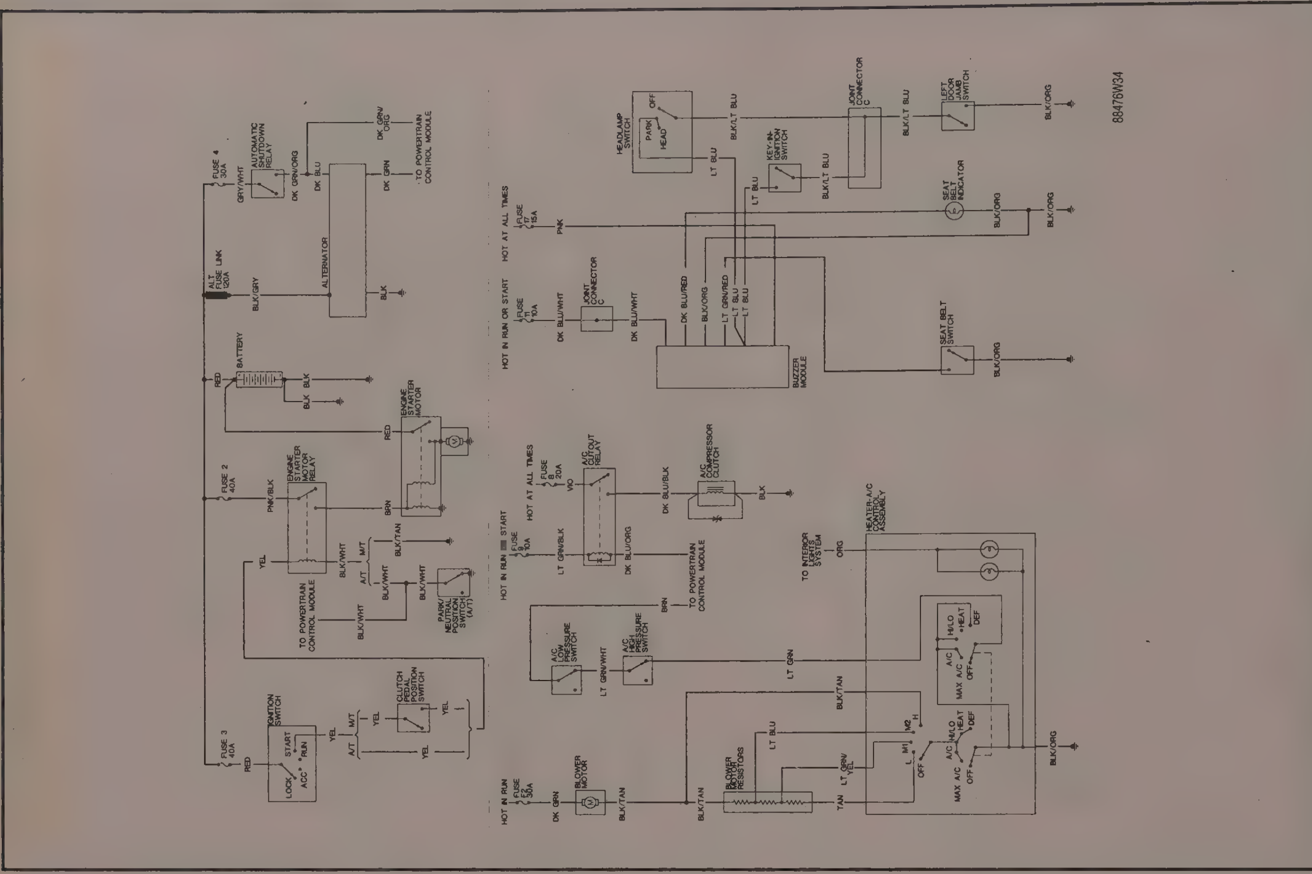

HOT AT ALL TIMES
FUSE 4 30A
AUTOMATIC SHUTDOWN RELAY
ALT FUSE LINK 120A
ALTERNATOR
TO POWERTRAIN CONTROL MODULE
BATTERY
ENGINE STARTER MOTOR
ENGINE STARTER MOTOR RELAY
FUSE 2 40A
PARK/NEUTRAL POSITION SWITCH (A/T)
CLUTCH PEDAL POSITION SWITCH
IGNITION SWITCH
FUSE 3 40A
LOCK
ACC
START
RUN
HOT IN RUN OR START
FUSE 11 10A
JOINT CONNECTOR C
FUSE 17 15A
HEADLAMP SWITCH
KEY-IN-IGNITION SWITCH
LEFT DOOR JAMB SWITCH
SEAT BELT INDICATOR
SEAT BELT SWITCH
BUZZER MODULE
FUSE 8 20A
A/C CUTOUT RELAY
A/C COMPRESSOR CLUTCH
FUSE 9 10A
A/C LOW PRESSURE SWITCH
A/C HIGH PRESSURE SWITCH
TO INTERIOR LIGHTS SYSTEM
HEATER-A/C CONTROL ASSEMBLY
HOT IN RUN
FUSE 22 30A
BLOWER MOTOR
BLOWER MOTOR RESISTORS
MAX A/C
OFF
HI/LO
HEAT
DEF
88476W34

Fig. 104 Chassis wiring—1994 Pick-ups

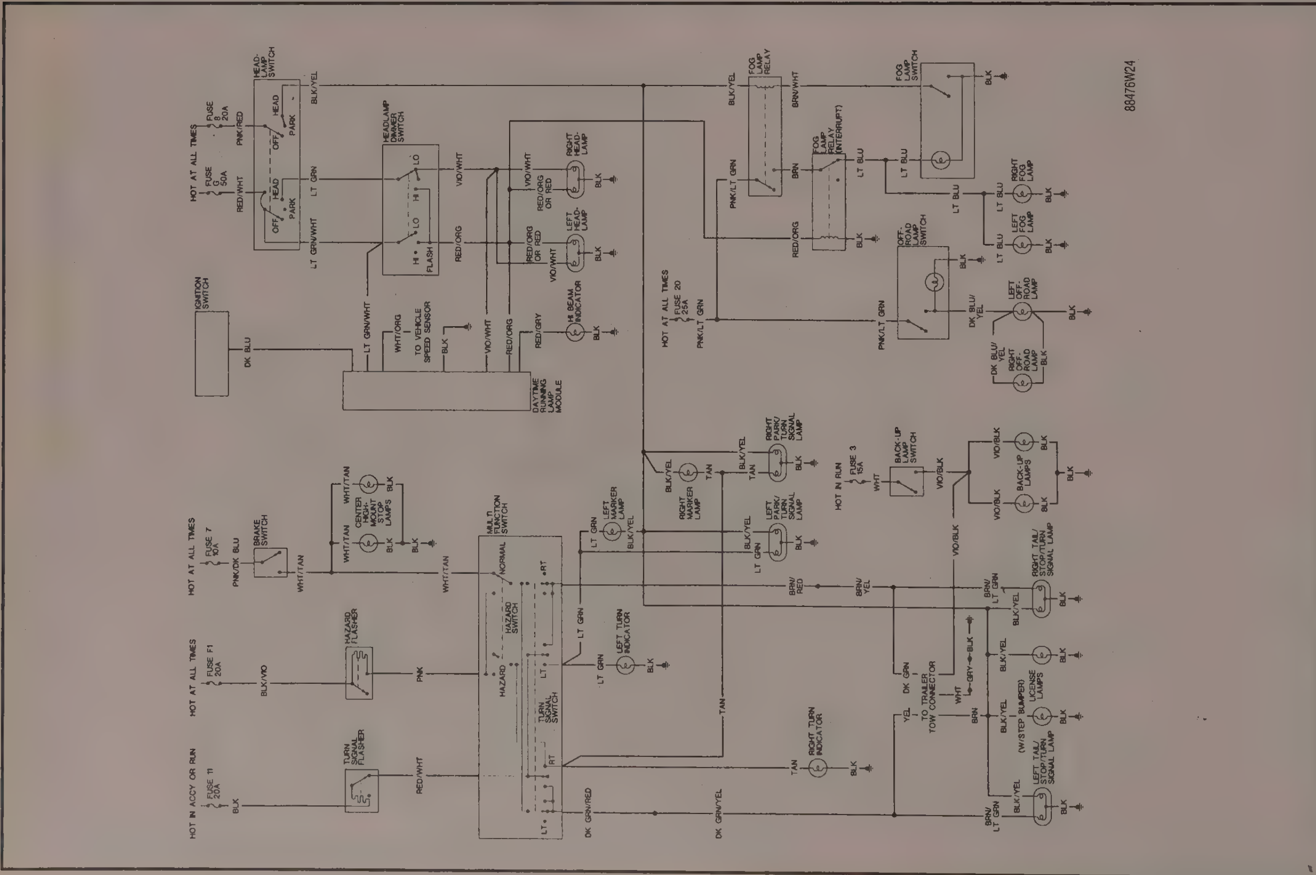

HOT AT ALL TIMES
FUSE G 50A
FUSE 8 20A
HEADLAMP SWITCH
IGNITION SWITCH
HEADLAMP DIMMER SWITCH
RIGHT HEADLAMP
LEFT HEADLAMP
HI BEAM INDICATOR
TO VEHICLE SPEED SENSOR
DAYTIME RUNNING LAMP MODULE
FOG LAMP RELAY
FOG LAMP RELAY (INTERRUPT)
FOG LAMP SWITCH
RIGHT FOG LAMP
LEFT FOG LAMP
FUSE 20 25A
OFF-ROAD LAMP SWITCH
LEFT OFF-ROAD LAMP
RIGHT OFF-ROAD LAMP
FUSE 7 10A
BRAKE SWITCH
CENTER HIGH-MOUNT STOP LAMPS
MULTI-FUNCTION SWITCH
HAZARD SWITCH
TURN SIGNAL SWITCH
LEFT MARKER LAMP
RIGHT MARKER LAMP
RIGHT PARK/TURN SIGNAL LAMP
LEFT PARK/TURN SIGNAL LAMP
HOT IN RUN
FUSE 3 15A
BACK-UP LAMP SWITCH
BACK-UP LAMPS
FUSE F1 20A
HAZARD FLASHER
LEFT TURN INDICATOR
HOT IN ACCY OR RUN
FUSE 11 20A
TURN SIGNAL FLASHER
RIGHT TURN INDICATOR
TO TRAILER TOW CONNECTOR
RIGHT TAIL/STOP/TURN SIGNAL LAMP
LICENSE LAMPS
(W/STEP BUMPER)
LEFT TAIL/STOP/TURN SIGNAL LAMP
88476W24

Fig. 103 Chassis wiring—1994 Dakota (continued)

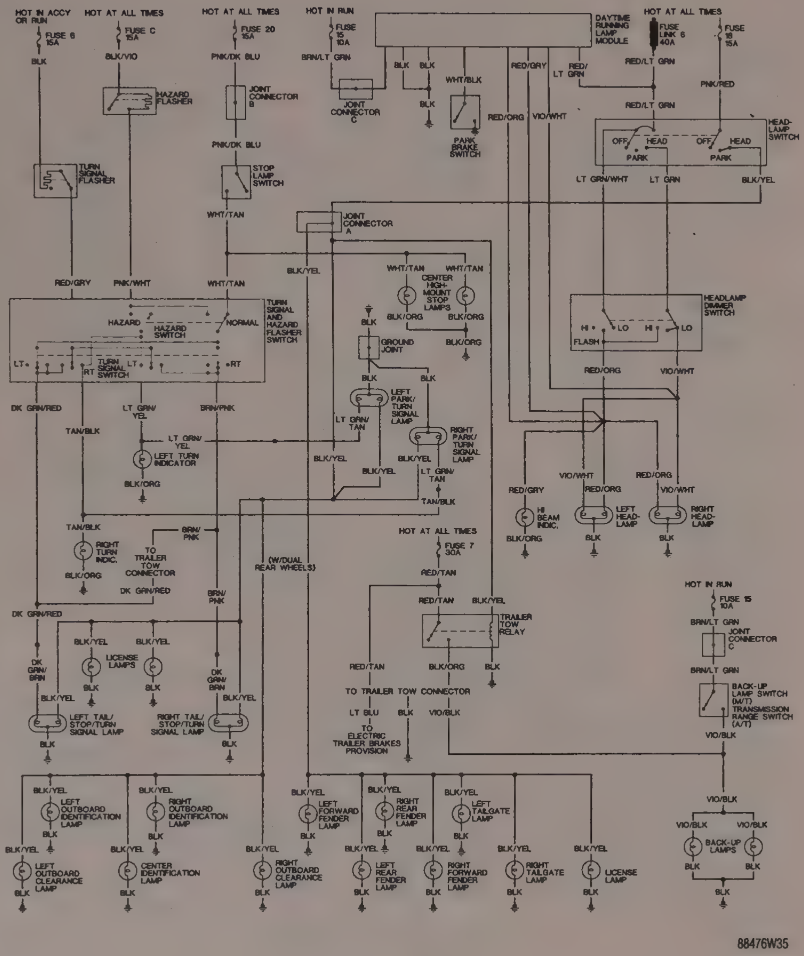

HOT IN ACCY OR RUN
FUSE 6 15A
HOT AT ALL TIMES
FUSE C 15A
FUSE 20 15A
HOT IN RUN
FUSE 15 10A
DAYTIME RUNNING LAMP MODULE
FUSE LINK 6 40A
FUSE 18 15A
HAZARD FLASHER
JOINT CONNECTOR B
JOINT CONNECTOR C
PARK BRAKE SWITCH
HEAD-LAMP SWITCH
TURN SIGNAL FLASHER
STOP LAMP SWITCH
JOINT CONNECTOR A
TURN SIGNAL AND HAZARD FLASHER SWITCH
HAZARD SWITCH
TURN SIGNAL SWITCH
CENTER HIGH-MOUNT STOP LAMPS
GROUND JOINT
LEFT PARK/TURN SIGNAL LAMP
RIGHT PARK/TURN SIGNAL LAMP
HEADLAMP DIMMER SWITCH
LEFT TURN INDICATOR
RIGHT TURN INDIC.
TO TRAILER TOW CONNECTOR
HI BEAM INDIC.
LEFT HEAD-LAMP
RIGHT HEAD-LAMP
(W/DUAL REAR WHEELS)
FUSE 7 30A
TRAILER TOW RELAY
TO TRAILER TOW CONNECTOR
TO ELECTRIC TRAILER BRAKES PROVISION
BACK-UP LAMP SWITCH (M/T) TRANSMISSION RANGE SWITCH (A/T)
LICENSE LAMPS
LEFT TAIL/STOP/TURN SIGNAL LAMP
RIGHT TAIL/STOP/TURN SIGNAL LAMP
LEFT OUTBOARD IDENTIFICATION LAMP
RIGHT OUTBOARD IDENTIFICATION LAMP
LEFT FORWARD FENDER LAMP
RIGHT REAR FENDER LAMP
LEFT TAILGATE LAMP
BACK-UP LAMPS
LEFT OUTBOARD CLEARANCE LAMP
CENTER IDENTIFICATION LAMP
RIGHT OUTBOARD CLEARANCE LAMP
LEFT REAR FENDER LAMP
RIGHT FORWARD FENDER LAMP
RIGHT TAILGATE LAMP
LICENSE LAMP
88476W35

Fig. 105 Chassis wiring—1994 Pick-ups (continued)

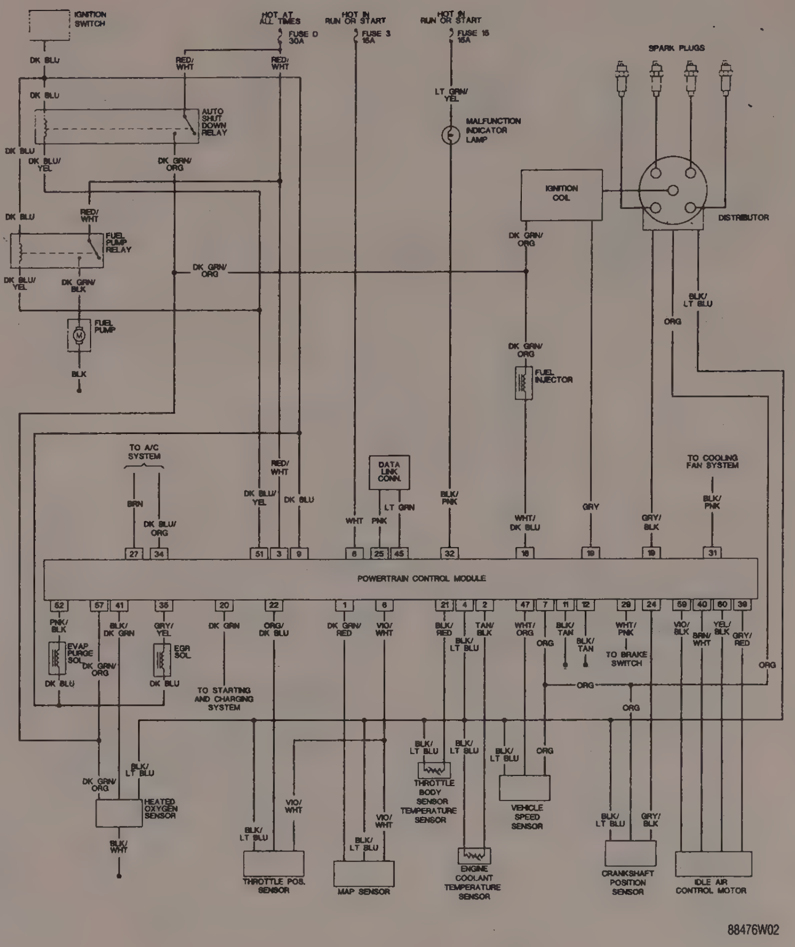

IGNITION SWITCH
HOT AT ALL TIMES
FUSE D 30A
HOT IN RUN OR START
FUSE 3 15A
FUSE 16 15A
SPARK PLUGS
AUTO SHUT DOWN RELAY
MALFUNCTION INDICATOR LAMP
IGNITION COIL
DISTRIBUTOR
FUEL PUMP RELAY
FUEL PUMP
FUEL INJECTOR
TO A/C SYSTEM
DATA LINK CONN.
TO COOLING FAN SYSTEM
POWERTRAIN CONTROL MODULE
EVAP PURGE SOL
EGR SOL
TO STARTING AND CHARGING SYSTEM
TO BRAKE SWITCH
HEATED OXYGEN SENSOR
THROTTLE POS. SENSOR
MAP SENSOR
THROTTLE BODY SENSOR TEMPERATURE SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
VEHICLE SPEED SENSOR
CRANKSHAFT POSITION SENSOR
IDLE AIR CONTROL MOTOR
88476W02

Fig. 106 Engine wiring—1994–95 2.5L Dakotas

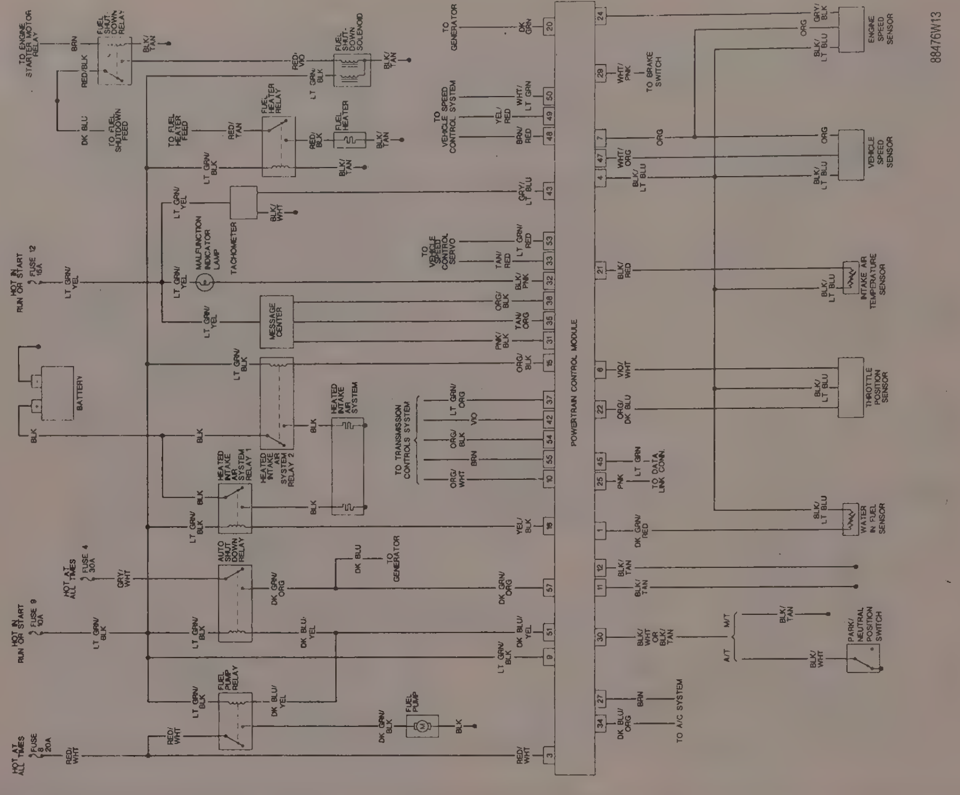

TO ENGINE STARTER MOTOR RELAY
FUEL SHUT-DOWN RELAY
TO FUEL SHUTDOWN FEED
FUEL SHUT-DOWN SOLENOID
TO FUEL HEATER FEED
FUEL HEATER RELAY
FUEL HEATER
HOT IN RUN OR START
FUSE 12 15A
MALFUNCTION INDICATOR LAMP
TACHOMETER
MESSAGE CENTER
BATTERY
HEATED INTAKE AIR SYSTEM RELAY 1
HEATED INTAKE AIR SYSTEM RELAY 2
HEATED INTAKE AIR SYSTEM
HOT AT ALL TIMES
FUSE 4 30A
AUTO SHUT DOWN RELAY
TO GENERATOR
FUSE 9 10A
FUEL PUMP RELAY
FUEL PUMP
FUSE 8 20A
TO GENERATOR
TO VEHICLE SPEED CONTROL SYSTEM
TO VEHICLE SPEED CONTROL SERVO
TO TRANSMISSION CONTROLS SYSTEM
POWERTRAIN CONTROL MODULE
TO BRAKE SWITCH
TO DATA LINK CONN.
TO A/C SYSTEM
ENGINE SPEED SENSOR
VEHICLE SPEED SENSOR
INTAKE AIR TEMPERATURE SENSOR
THROTTLE POSITION SENSOR
WATER IN FUEL SENSOR
PARK/ NEUTRAL POSITION SWITCH
M/T
A/T
88476W13

Fig. 108 Engine wiring—1994-95 5.9L diesel Pick-ups

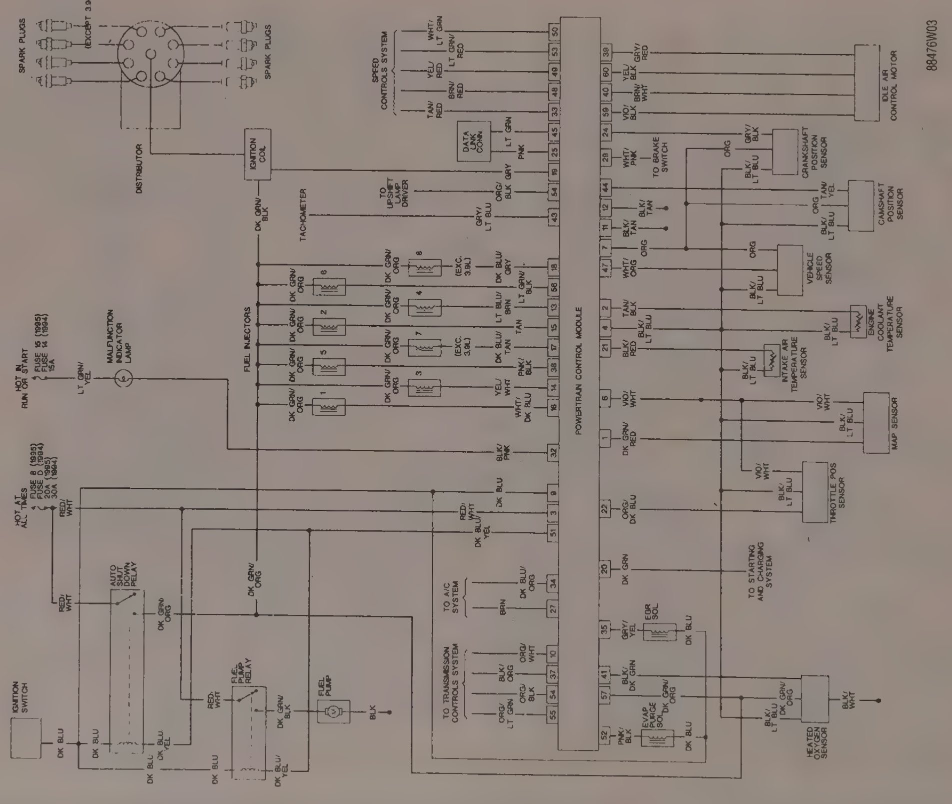

SPARK PLUGS
(EXCEPT 3.9L)
DISTRIBUTOR
IGNITION COIL
SPEED CONTROLS SYSTEM
DATA LINK CONN.
TO UPSHIFT LAMP DRIVER
TACHOMETER
FUEL INJECTORS
(EXC. 3.9L)
HOT IN RUN OR START
FUSE 15 (1995) FUSE 14 (1994) 15A
MALFUNCTION INDICATOR LAMP
HOT AT ALL TIMES
FUSE 8 (1995) FUSE 5 (1994) 20A (1995) 30A (1994)
AUTO SHUT DOWN RELAY
TO A/C SYSTEM
IGNITION SWITCH
FUEL PUMP RELAY
FUEL PUMP
TO TRANSMISSION CONTROLS SYSTEM
POWERTRAIN CONTROL MODULE
TO BRAKE SWITCH
CRANKSHAFT POSITION SENSOR
CAMSHAFT POSITION SENSOR
VEHICLE SPEED SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
MAP SENSOR
THROTTLE POS SENSOR
TO STARTING AND CHARGING SYSTEM
EGR SOL
EVAP PURGE SOL
HEATED OXYGEN SENSOR
IDLE AIR CONTROL MOTOR
88476W03

Fig. 107 Engine wiring—1994-95 3.9L and 5.2L Dakotas

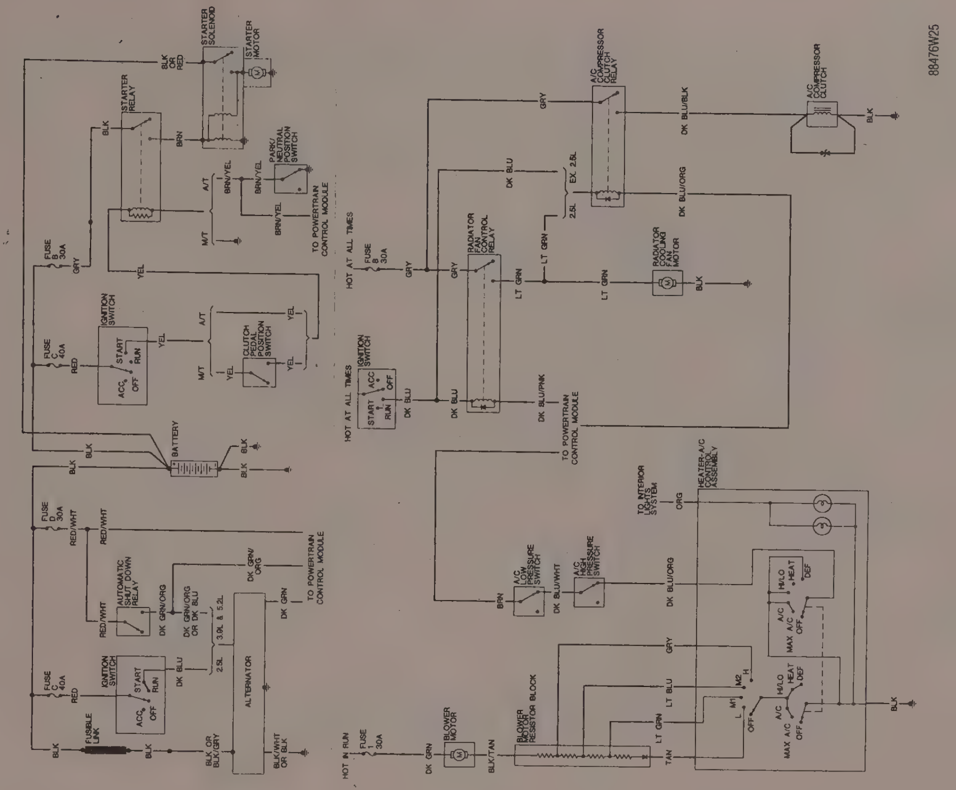

STARTER SOLENOID
STARTER MOTOR
STARTER RELAY
PARK/NEUTRAL POSITION SWITCH
TO POWERTRAIN CONTROL MODULE
IGNITION SWITCH
CLUTCH PEDAL POSITION SWITCH
BATTERY
FUSE B 30A
FUSE C 40A
FUSE D 30A
AUTOMATIC SHUT DOWN RELAY
ALTERNATOR
FUSIBLE LINK
HOT AT ALL TIMES
HOT IN RUN
RADIATOR FAN CONTROL RELAY
RADIATOR COOLING FAN MOTOR
A/C COMPRESSOR CLUTCH RELAY
A/C COMPRESSOR CLUTCH
A/C LOW PRESSURE SWITCH
A/C HIGH PRESSURE SWITCH
BLOWER MOTOR
BLOWER MOTOR RESISTOR BLOCK
TO INTERIOR LIGHTS SYSTEM
HEATER-A/C CONTROL ASSEMBLY
88476W25

Fig. 110 Chassis wiring—1995 Dakota

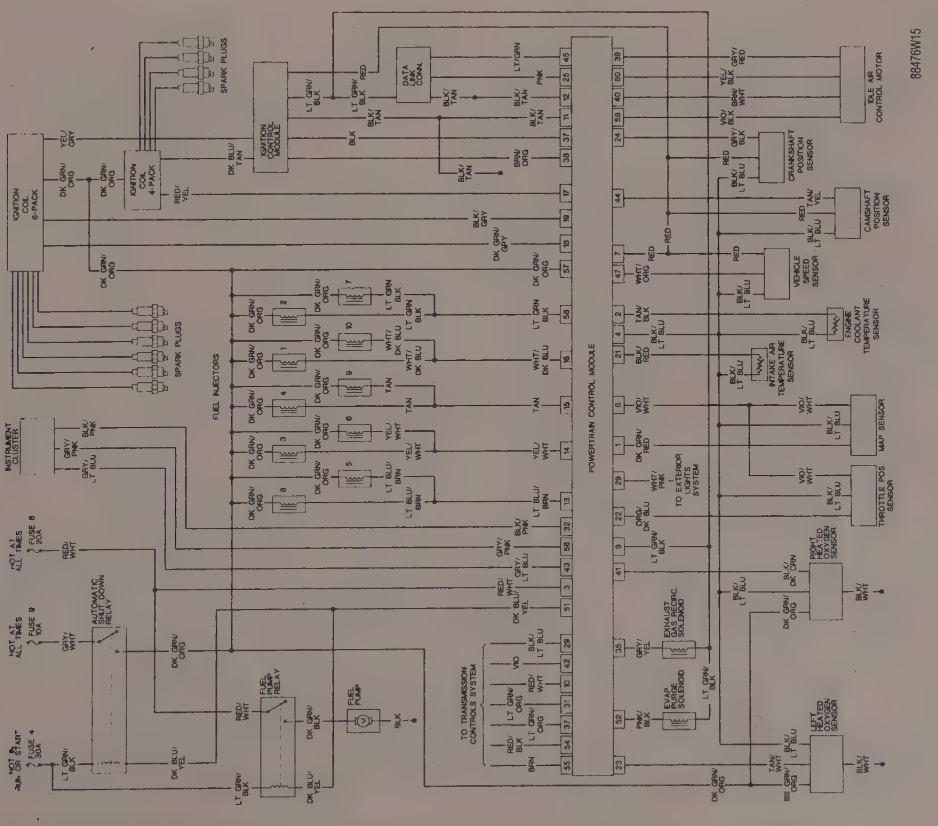

IGNITION COIL 6-PACK
IGNITION COIL 4-PACK
SPARK PLUGS
IGNITION CONTROL MODULE
DATA LINK CONN.
FUEL INJECTORS
INSTRUMENT CLUSTER
HOT AT ALL TIMES
FUSE 8 20A
FUSE 9 10A
HOT IN RUN OR START
FUSE 4 30A
AUTOMATIC SHUT DOWN RELAY
FUEL PUMP RELAY
FUEL PUMP
TO TRANSMISSION CONTROLS SYSTEM
POWERTRAIN CONTROL MODULE
IDLE AIR CONTROL MOTOR
CRANKSHAFT POSITION SENSOR
CAMSHAFT POSITION SENSOR
VEHICLE SPEED SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
MAP SENSOR
THROTTLE POS SENSOR
TO EXTERIOR LIGHTS SYSTEM
RIGHT HEATED OXYGEN SENSOR
EXHAUST GAS RECIRC SOLENOID
EVAP PURGE SOLENOID
LEFT HEATED OXYGEN SENSOR
88476W15

Fig. 109 Engine wiring—1994–95 8.0L Pick-ups

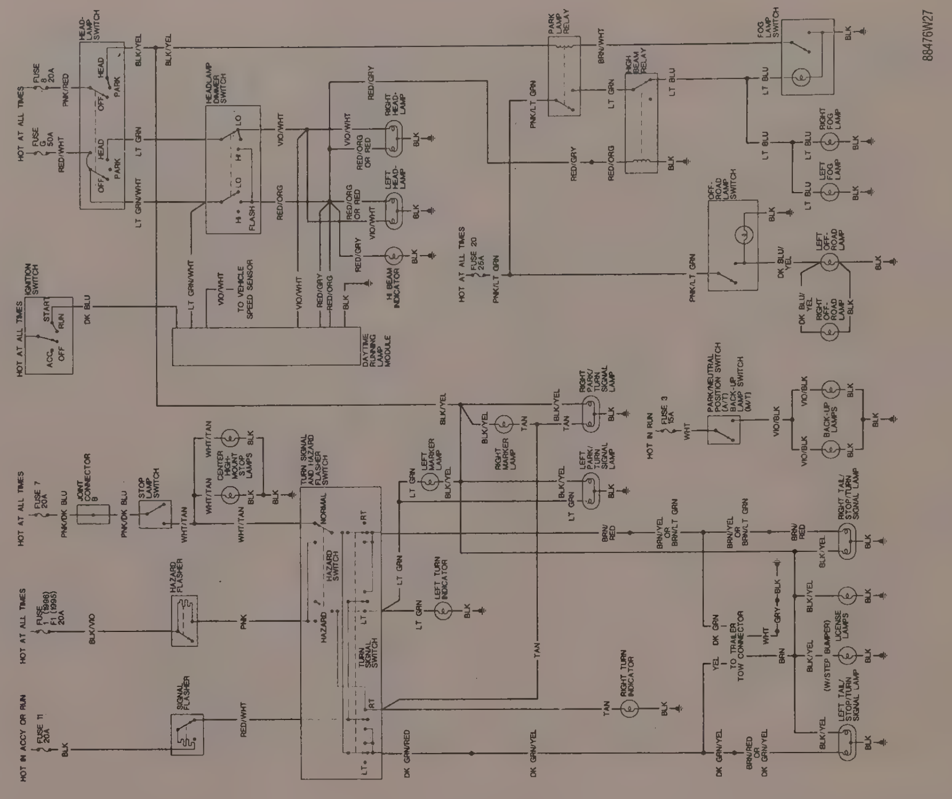

HOT AT ALL TIMES
FUSE G 50A
FUSE 8 20A
HEAD-LAMP SWITCH
HEADLAMP DIMMER SWITCH
RIGHT HEAD-LAMP
LEFT HEAD-LAMP
HI BEAM INDICATOR
PARK LAMP RELAY
HIGH BEAM RELAY
FOG LAMP SWITCH
RIGHT FOG LAMP
LEFT FOG LAMP
IGNITION SWITCH
TO VEHICLE SPEED SENSOR
DAYTIME RUNNING LAMP MODULE
FUSE 20 25A
OFF-ROAD LAMP SWITCH
LEFT OFF-ROAD LAMP
RIGHT OFF-ROAD LAMP
FUSE 7 20A
JOINT CONNECTOR 9
STOP LAMP SWITCH
CENTER HIGH-MOUNT STOP LAMPS
TURN SIGNAL AND HAZARD FLASHER SWITCH
LEFT MARKER LAMP
RIGHT MARKER LAMP
RIGHT PARK/TURN SIGNAL LAMP
LEFT PARK/TURN SIGNAL LAMP
HOT IN RUN
FUSE 3 15A
PARK/NEUTRAL POSITION SWITCH (A/T) BACK-UP LAMP SWITCH (M/T)
BACK-UP LAMPS
FUSE F (1996) F1 (1995) 20A
HAZARD FLASHER
HAZARD SWITCH
TURN SIGNAL SWITCH
LEFT TURN INDICATOR
RIGHT TURN INDICATOR
TO TRAILER TOW CONNECTOR
RIGHT TAIL/STOP/TURN SIGNAL LAMP
LICENSE LAMPS (W/STEP BUMPER)
LEFT TAIL/STOP/TURN SIGNAL LAMP
HOT IN ACCY OR RUN
FUSE 11 20A
SIGNAL FLASHER
88476W27

Fig. 112 Chassis wiring—1995–96 Dakotas (continued)

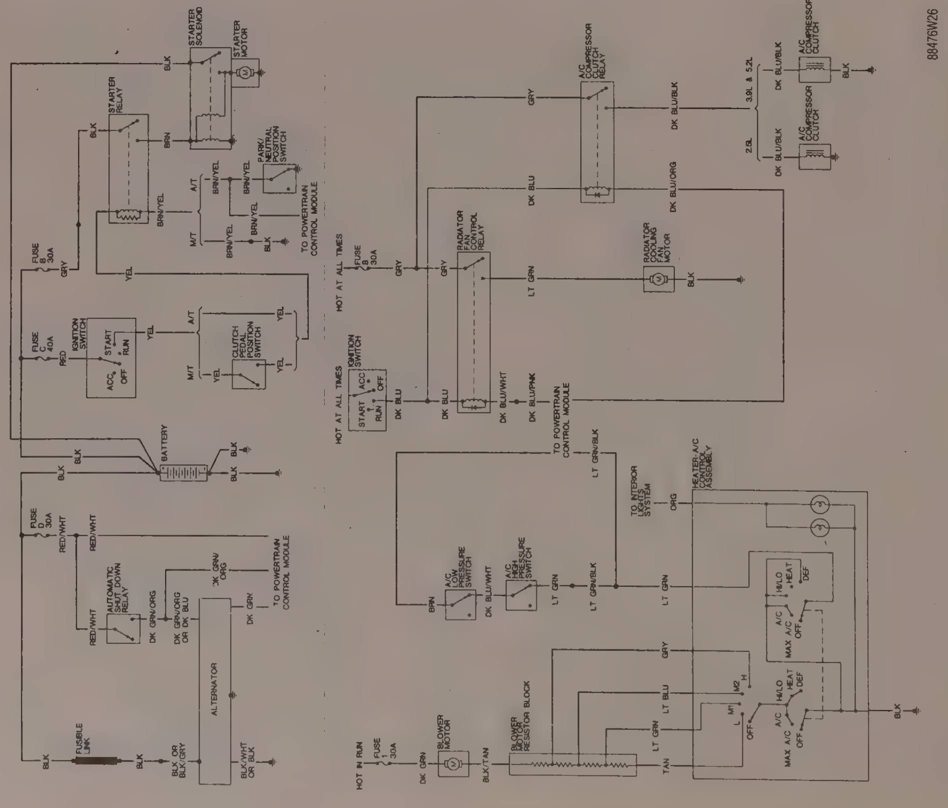

STARTER SOLENOID
STARTER MOTOR
STARTER RELAY
PARK/NEUTRAL POSITION SWITCH
TO POWERTRAIN CONTROL MODULE
FUSE B 30A
FUSE C 40A
IGNITION SWITCH
CLUTCH PEDAL POSITION SWITCH
BATTERY
FUSE D 30A
AUTOMATIC SHUT DOWN RELAY
ALTERNATOR
FUSIBLE LINK
HOT AT ALL TIMES
FUSE 8 30A
RADIATOR FAN CONTROL RELAY
RADIATOR COOLING FAN MOTOR
A/C COMPRESSOR CLUTCH RELAY
A/C COMPRESSOR CLUTCH
2.5L
3.9L & 5.2L
TO INTERIOR LIGHTS SYSTEM
HEATER-A/C CONTROL ASSEMBLY
A/C LOW PRESSURE SWITCH
A/C HIGH PRESSURE SWITCH
HOT IN RUN
FUSE 1 30A
BLOWER MOTOR
BLOWER MOTOR RESISTOR BLOCK
88476W26

Fig. 111 Chassis wiring—1996 Dakota

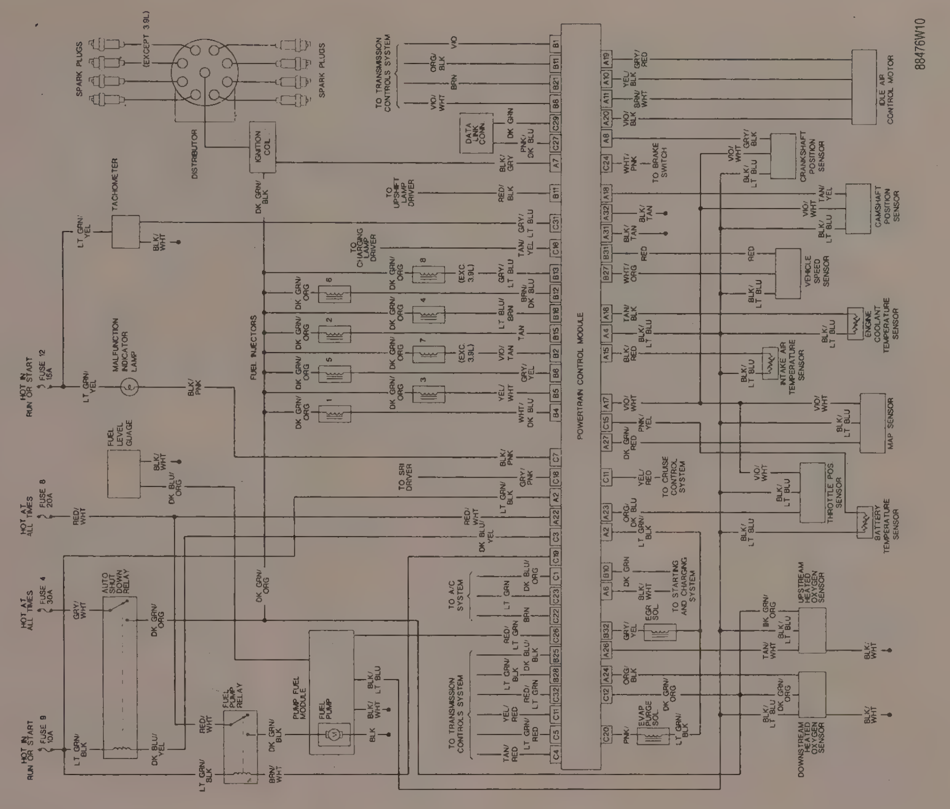

SPARK PLUGS
(EXCEPT 3.9L)
DISTRIBUTOR
IGNITION COIL
TACHOMETER
HOT IN RUN OR START FUSE 12 15A
MALFUNCTION INDICATOR LAMP
FUEL LEVEL GUAGE
HOT AT ALL TIMES FUSE 8 20A
HOT AT ALL TIMES FUSE 4 30A
AUTO SHUT DOWN RELAY
HOT IN RUN OR START FUSE 9 10A
FUEL PUMP RELAY
PUMP FUEL MODULE
FUEL PUMP
FUEL INJECTORS
TO TRANSMISSION CONTROLS SYSTEM
DATA LINK CONN.
TO UPSHIFT LAMP DRIVER
TO CHARGING LAMP DRIVER
TO SRI DRIVER
TO A/C SYSTEM
POWERTRAIN CONTROL MODULE
TO BRAKE SWITCH
TO CRUISE CONTROL SYSTEM
TO STARTING AND CHARGING SYSTEM
EGR SOL
EVAP PURGE SOL
IDLE AIR CONTROL MOTOR
CRANKSHAFT POSITION SENSOR
CAMSHAFT POSITION SENSOR
VEHICLE SPEED SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
MAP SENSOR
THROTTLE POS SENSOR
BATTERY TEMPERATURE SENSOR
UPSTREAM HEATED OXYGEN SENSOR
DOWNSTREAM HEATED OXYGEN SENSOR
88476W10

Fig. 114 Engine wiring—1996 3.9L, 5.2L and 5.9L gasoline engine Pick-up

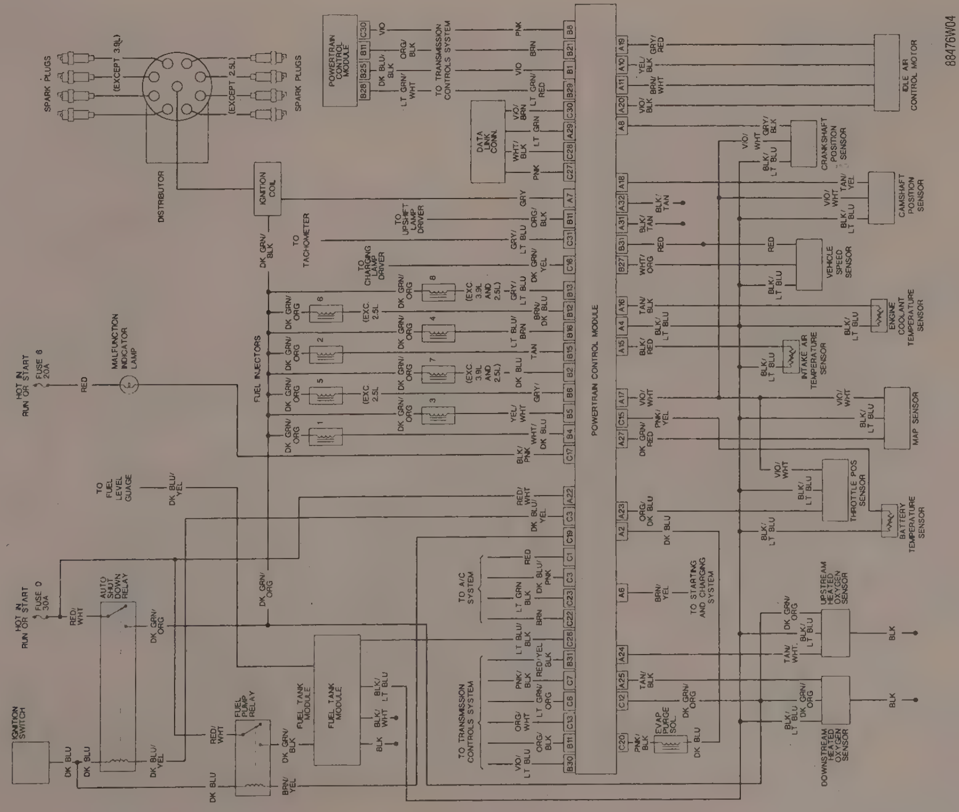
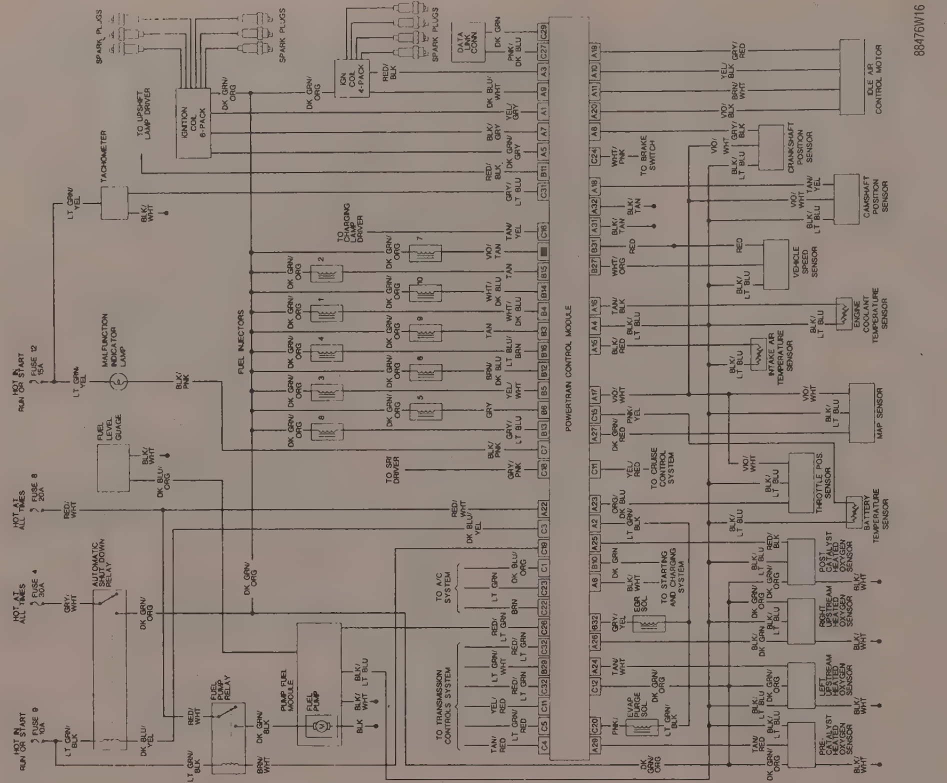
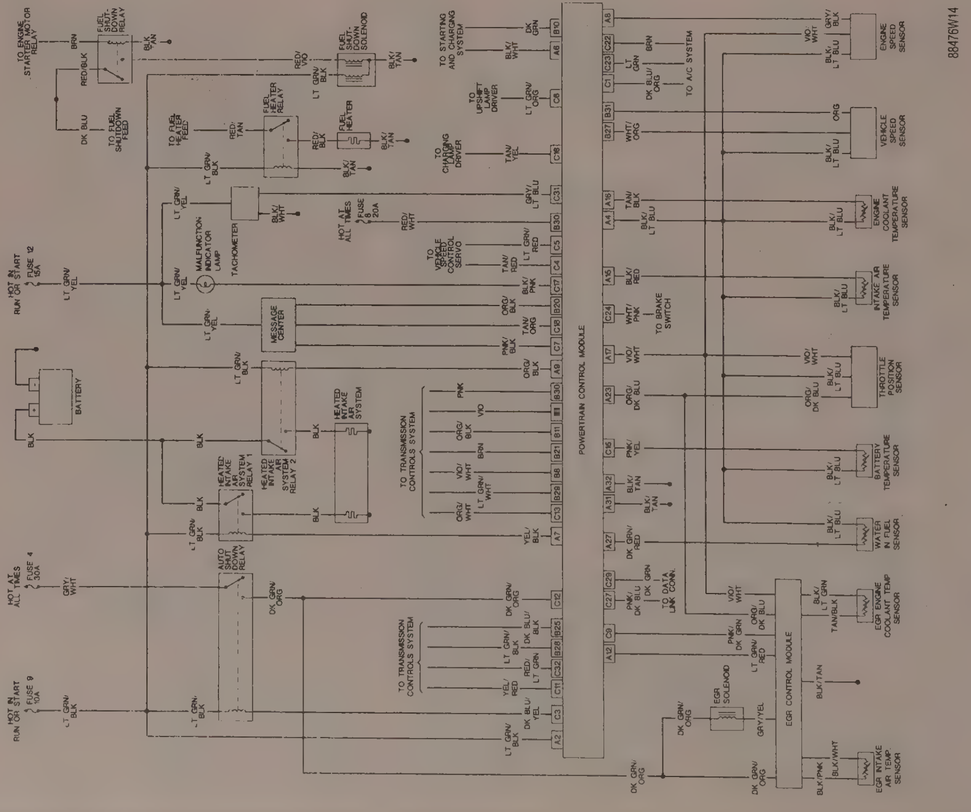

SPARK PLUGS
(EXCEPT 3.9L)
(EXCEPT 2.5L)
DISTRIBUTOR
IGNITION COIL
TO TACHOMETER
POWERTRAIN CONTROL MODULE
HOT IN RUN OR START FUSE 8 20A
MALFUNCTION INDICATOR LAMP
TO FUEL LEVEL GUAGE
HOT IN RUN OR START FUSE 0 30A
AUTO SHUT DOWN RELAY
IGNITION SWITCH
FUEL PUMP RELAY
FUEL TANK MODULE
FUEL INJECTORS
TO TRANSMISSION CONTROLS SYSTEM
DATA LINK CONN.
TO UPSHIFT LAMP DRIVER
TO CHARGING LAMP DRIVER
TO A/C SYSTEM
TO STARTING AND CHARGING SYSTEM
EVAP PURGE SOL
IDLE AIR CONTROL MOTOR
CRANKSHAFT POSITION SENSOR
CAMSHAFT POSITION SENSOR
VEHICLE SPEED SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
MAP SENSOR
THROTTLE POS SENSOR
BATTERY TEMPERATURE SENSOR
UPSTREAM HEATED OXYGEN SENSOR
DOWNSTREAM HEATED OXYGEN SENSOR
88476W04

Fig. 113 Engine wiring—1996 2.5L, 3.9L and 5.2L Dakota



88476W16
POWERTRAIN CONTROL MODULE
SPARK PLUGS
IGNITION COIL 6-PACK
IGN COIL 4-PACK
DATA LINK CONN
TO UPSHIFT LAMP DRIVER
TACHOMETER
TO CHARGING LAMP DRIVER
FUEL INJECTORS
HOT IN RUN OR START
FUSE 12 15A
MALFUNCTION INDICATOR LAMP
FUEL LEVEL GUAGE
HOT AT ALL TIMES
FUSE 8 20A
AUTOMATIC SHUT DOWN RELAY
FUSE 4 30A
FUSE 9 10A
FUEL PUMP RELAY
PUMP FUEL MODULE
FUEL PUMP
TO SRI DRIVER
TO A/C SYSTEM
TO TRANSMISSION CONTROLS SYSTEM
TO BRAKE SWITCH
TO CRUISE CONTROL SYSTEM
TO STARTING AND CHARGING SYSTEM
EGR SOL
EVAP PURGE SOL
IDLE AIR CONTROL MOTOR
CRANKSHAFT POSITION SENSOR
CAMSHAFT POSITION SENSOR
VEHICLE SPEED SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
MAP SENSOR
THROTTLE POS SENSOR
BATTERY TEMPERATURE SENSOR
POST CATALYST HEATED OXYGEN SENSOR
RIGHT UPSTREAM HEATED OXYGEN SENSOR
LEFT UPSTREAM HEATED OXYGEN SENSOR
PRE-CATALYST HEATED OXYGEN SENSOR

Fig. 116 Engine wiring—1996 8.0L Pick-up



88476W14
POWERTRAIN CONTROL MODULE
EGR CONTROL MODULE
TO ENGINE STARTER MOTOR RELAY
FUEL SHUT-DOWN RELAY
TO FUEL SHUTDOWN FEED
FUEL SHUT-DOWN SOLENOID
TO FUEL HEATER FEED
FUEL HEATER RELAY
FUEL HEATER
TO STARTING AND CHARGING SYSTEM
TO UPSHIFT LAMP DRIVER
TO CHARGING LAMP DRIVER
HOT IN RUN OR START
FUSE 12 15A
TACHOMETER
MALFUNCTION INDICATOR LAMP
HOT AT ALL TIMES
FUSE 8 20A
TO VEHICLE SPEED CONTROL SERVO
MESSAGE CENTER
BATTERY
HEATED INTAKE AIR SYSTEM
HEATED INTAKE AIR SYSTEM RELAY 1
HEATED INTAKE AIR SYSTEM RELAY 2
TO TRANSMISSION CONTROLS SYSTEM
FUSE 4 30A
AUTO SHUT DOWN RELAY
FUSE 9 10A
TO A/C SYSTEM
TO BRAKE SWITCH
TO DATA LINK CONN.
EGR SOLENOID
ENGINE SPEED SENSOR
VEHICLE SPEED SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
THROTTLE POSITION SENSOR
BATTERY TEMPERATURE SENSOR
WATER IN FUEL SENSOR
EGR ENGINE COOLANT TEMP SENSOR
EGR INTAKE AIR TEMP SENSOR

Fig. 115 Engine wiring—1996 5.9L diesel Pick-up

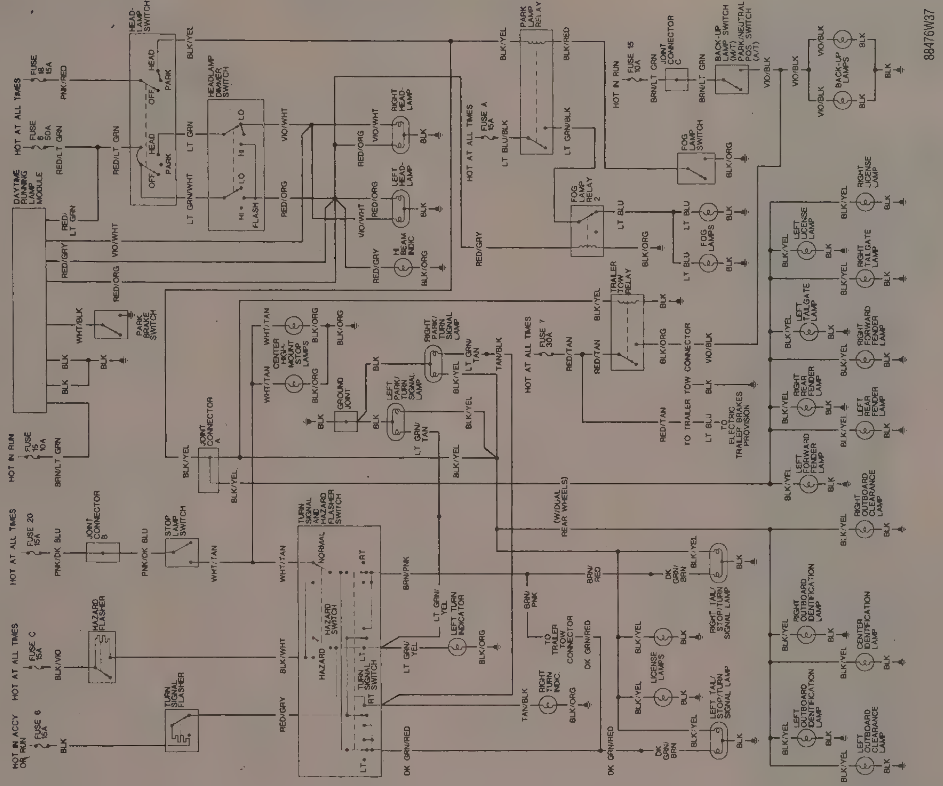

DAYTIME RUNNING LAMP MODULE
HOT AT ALL TIMES
FUSE 6 50A
FUSE 18 15A
HEADLAMP SWITCH
HEADLAMP DIMMER SWITCH
RIGHT HEADLAMP
LEFT HEADLAMP
HI BEAM INDIC
PARK BRAKE SWITCH
PARK LAMP RELAY
HOT AT ALL TIMES FUSE A 15A
HOT IN RUN FUSE 15 10A
JOINT CONNECTOR C
BACK-UP LAMP SWITCH (M/T) PARK/NEUTRAL POS. SWITCH (A/T)
BACK-UP LAMPS
FOG LAMP SWITCH
FOG LAMP RELAY 2
FOG LAMPS
TRAILER TOW RELAY
HOT AT ALL TIMES FUSE 7 30A
TRAILER TOW CONNECTOR
TO ELECTRIC TRAILER BRAKES PROVISION
CENTER HIGH-MOUNT STOP LAMPS
GROUND JOINT
LEFT PARK/TURN SIGNAL LAMP
RIGHT PARK/TURN SIGNAL LAMP
HOT IN RUN FUSE 15 10A
JOINT CONNECTOR A
HOT AT ALL TIMES FUSE 20 15A
JOINT CONNECTOR B
STOP LAMP SWITCH
TURN SIGNAL AND HAZARD FLASHER SWITCH
HOT AT ALL TIMES FUSE C 15A
HAZARD FLASHER
HOT IN ACCY OR RUN FUSE 6 15A
TURN SIGNAL FLASHER
HAZARD SWITCH
TURN SIGNAL SWITCH
LEFT TURN INDICATOR
RIGHT TURN INDIC
TO TRAILER TOW CONNECTOR
(W/DUAL REAR WHEELS)
LICENSE LAMPS
LEFT TAIL/STOP/TURN SIGNAL LAMP
RIGHT TAIL/STOP/TURN SIGNAL LAMP
LEFT LICENSE LAMP
RIGHT LICENSE LAMP
LEFT TAILGATE LAMP
RIGHT TAILGATE LAMP
RIGHT REAR FENDER LAMP
RIGHT FORWARD FENDER LAMP
LEFT FORWARD FENDER LAMP
LEFT REAR FENDER LAMP
RIGHT OUTBOARD CLEARANCE LAMP
RIGHT OUTBOARD IDENTIFICATION LAMP
CENTER IDENTIFICATION LAMP
LEFT OUTBOARD IDENTIFICATION LAMP
LEFT OUTBOARD CLEARANCE LAMP
88476W37

Fig. 118 Chassis wiring—1995 Pick-up (continued)

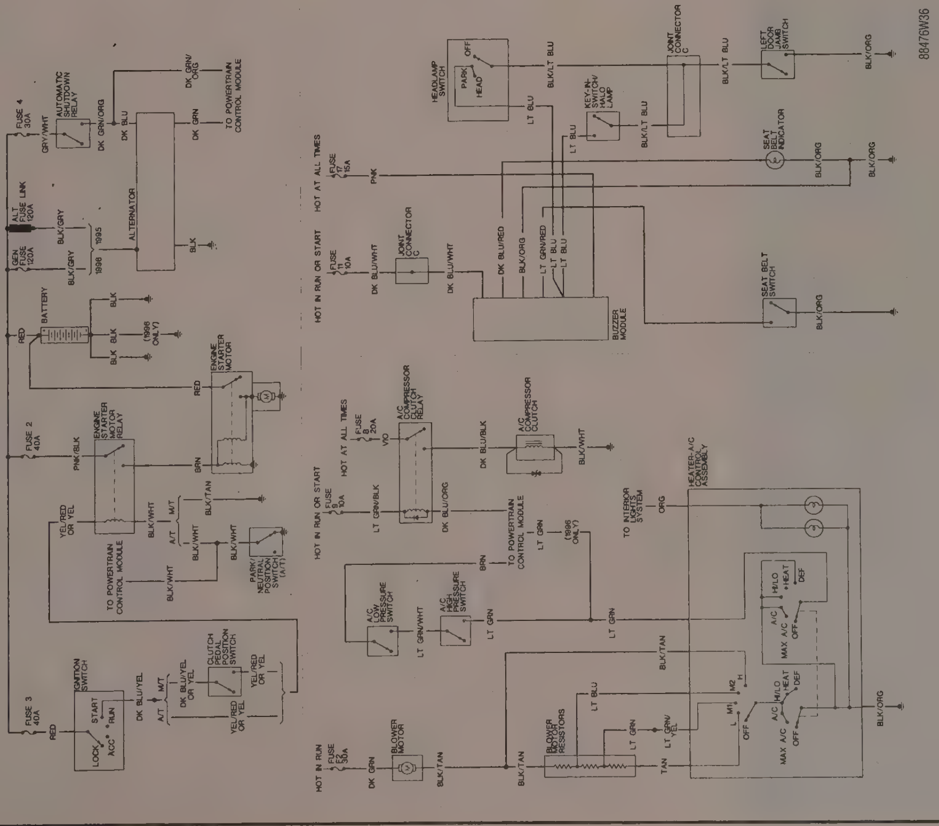

FUSE 4 30A
AUTOMATIC SHUTDOWN RELAY
TO POWERTRAIN CONTROL MODULE
ALT FUSE 120A
GEN FUSE 120A
1995
1996
ALTERNATOR
BATTERY
(1996 ONLY)
ENGINE STARTER MOTOR
FUSE 2 40A
ENGINE STARTER MOTOR RELAY
TO POWERTRAIN CONTROL MODULE
PARK/NEUTRAL POSITION SWITCH (A/T)
FUSE 3 40A
IGNITION SWITCH
LOCK ACC START RUN
CLUTCH PEDAL POSITION SWITCH
HOT AT ALL TIMES FUSE 17 15A
HOT IN RUN OR START FUSE 11 10A
JOINT CONNECTOR C
BUZZER MODULE
HEADLAMP SWITCH
KEY-IN-SWITCH/HALO LAMP
JOINT CONNECTOR C
LEFT DOOR JAMB SWITCH
SEAT BELT INDICATOR
SEAT BELT SWITCH
HOT AT ALL TIMES FUSE 8 20A
A/C COMPRESSOR CLUTCH RELAY
A/C COMPRESSOR CLUTCH
HOT IN RUN OR START FUSE 9 10A
TO POWERTRAIN CONTROL MODULE
(1996 ONLY)
A/C LOW PRESSURE SWITCH
A/C HIGH PRESSURE SWITCH
TO INTERIOR LIGHTS SYSTEM
HEATER-A/C CONTROL ASSEMBLY
HOT IN RUN FUSE 12 30A
BLOWER MOTOR
BLOWER MOTOR RESISTORS
MAX A/C
HI/LO
HEAT
DEF
OFF
88476W36

Fig. 117 Chassis wiring—1995–96 Pick-ups

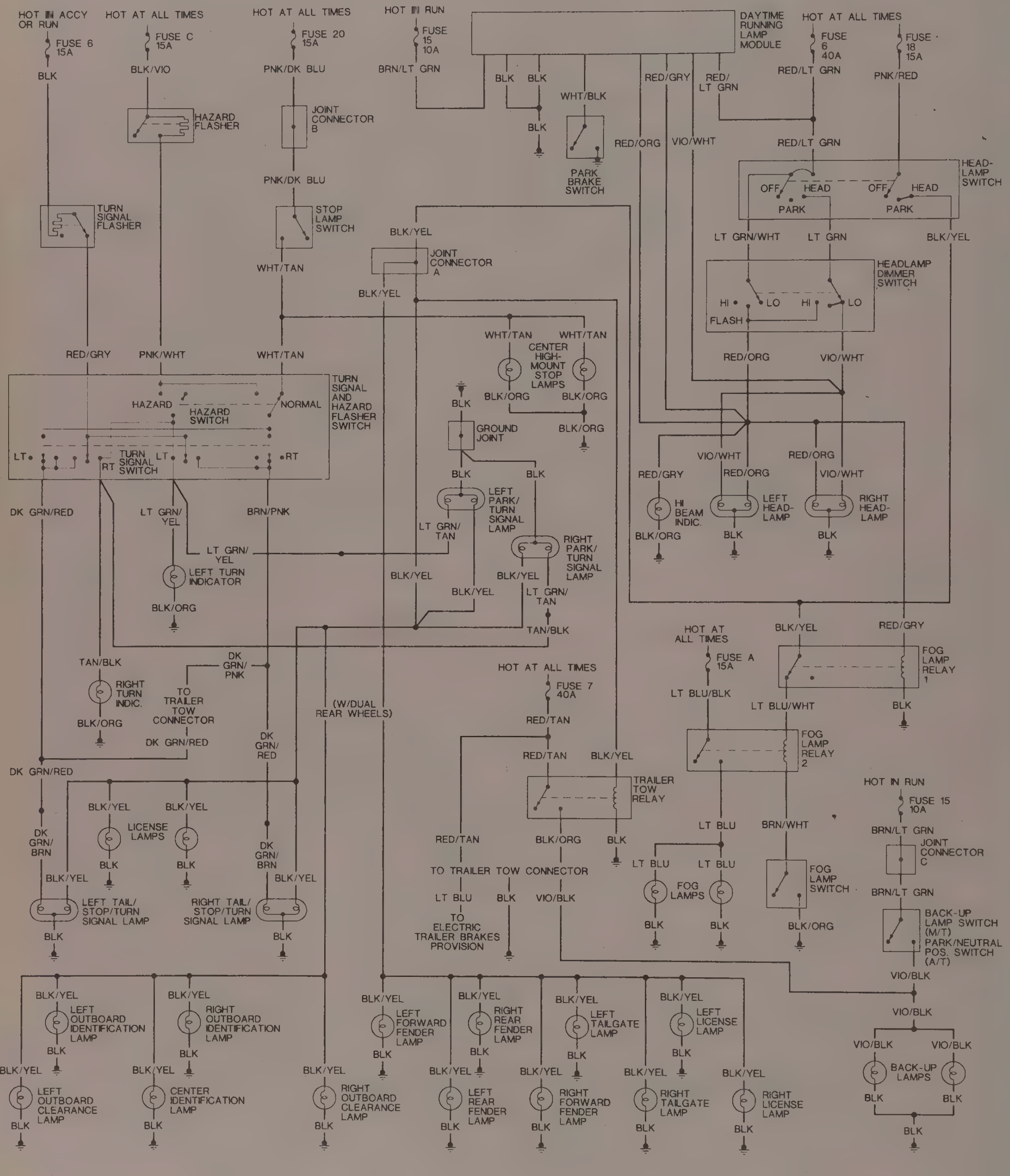

HOT IN ACCY OR RUN
FUSE 6 15A
BLK
HOT AT ALL TIMES
FUSE C 15A
BLK/VIO
HAZARD FLASHER
HOT AT ALL TIMES
FUSE 20 15A
PNK/DK BLU
JOINT CONNECTOR B
PNK/DK BLU
STOP LAMP SWITCH
WHT/TAN
HOT IN RUN
FUSE 15 10A
BRN/LT GRN
DAYTIME RUNNING LAMP MODULE
BLK
BLK
BLK
WHT/BLK
PARK BRAKE SWITCH
RED/GRY
RED/LT GRN
RED/ORG
VIO/WHT
HOT AT ALL TIMES
FUSE 6 40A
RED/LT GRN
RED/LT GRN
FUSE 18 15A
PNK/RED
HEADLAMP SWITCH
OFF
HEAD
PARK
OFF
HEAD
PARK
LT GRN/WHT
LT GRN
BLK/YEL
HEADLAMP DIMMER SWITCH
HI
LO
HI
LO
FLASH
RED/ORG
VIO/WHT
TURN SIGNAL FLASHER
BLK/YEL
JOINT CONNECTOR A
BLK/YEL
RED/GRY
PNK/WHT
WHT/TAN
WHT/TAN
WHT/TAN
CENTER HIGH-MOUNT STOP LAMPS
BLK/ORG
BLK/ORG
BLK/ORG
TURN SIGNAL AND HAZARD FLASHER SWITCH
HAZARD
HAZARD SWITCH
NORMAL
LT
TURN SIGNAL SWITCH
RT
LT
RT
BLK
GROUND JOINT
BLK
BLK
LEFT PARK/TURN SIGNAL LAMP
RIGHT PARK/TURN SIGNAL LAMP
VIO/WHT
RED/ORG
RED/GRY
RED/ORG
VIO/WHT
HI BEAM INDIC.
LEFT HEADLAMP
RIGHT HEADLAMP
BLK/ORG
BLK
BLK
DK GRN/RED
LT GRN/YEL
BRN/PNK
LT GRN/YEL
LEFT TURN INDICATOR
BLK/ORG
LT GRN/TAN
BLK/YEL
BLK/YEL
BLK/YEL
LT GRN/TAN
TAN/BLK
TAN/BLK
RIGHT TURN INDIC.
BLK/ORG
DK GRN/PNK
TO TRAILER TOW CONNECTOR
DK GRN/RED
DK GRN/RED
(W/DUAL REAR WHEELS)
DK GRN/RED
HOT AT ALL TIMES
FUSE 7 40A
RED/TAN
RED/TAN
BLK/YEL
TRAILER TOW RELAY
RED/TAN
BLK/ORG
BLK
TO TRAILER TOW CONNECTOR
LT BLU
BLK
VIO/BLK
TO ELECTRIC TRAILER BRAKES PROVISION
HOT AT ALL TIMES
FUSE A 15A
LT BLU/BLK
BLK/YEL
RED/GRY
FOG LAMP RELAY 1
LT BLU/WHT
BLK
FOG LAMP RELAY 2
LT BLU
BRN/WHT
LT BLU
LT BLU
FOG LAMPS
FOG LAMP SWITCH
BLK
BLK
BLK/ORG
HOT IN RUN
FUSE 15 10A
BRN/LT GRN
JOINT CONNECTOR C
BRN/LT GRN
BACK-UP LAMP SWITCH (M/T) PARK/NEUTRAL POS. SWITCH (A/T)
VIO/BLK
VIO/BLK
VIO/BLK
VIO/BLK
BACK-UP LAMPS
BLK
BLK
BLK
BLK/YEL
BLK/YEL
LICENSE LAMPS
BLK
BLK
DK GRN/BRN
DK GRN/BRN
BLK/YEL
BLK/YEL
LEFT TAIL/STOP/TURN SIGNAL LAMP
RIGHT TAIL/STOP/TURN SIGNAL LAMP
BLK
BLK
BLK/YEL
LEFT OUTBOARD IDENTIFICATION LAMP
BLK
BLK/YEL
RIGHT OUTBOARD IDENTIFICATION LAMP
BLK
BLK/YEL
LEFT FORWARD FENDER LAMP
BLK
BLK/YEL
RIGHT REAR FENDER LAMP
BLK
BLK/YEL
LEFT TAILGATE LAMP
BLK
BLK/YEL
LEFT LICENSE LAMP
BLK
BLK/YEL
LEFT OUTBOARD CLEARANCE LAMP
BLK
BLK/YEL
CENTER IDENTIFICATION LAMP
BLK
BLK/YEL
RIGHT OUTBOARD CLEARANCE LAMP
BLK
BLK/YEL
LEFT REAR FENDER LAMP
BLK
BLK/YEL
RIGHT FORWARD FENDER LAMP
BLK
BLK/YEL
RIGHT TAILGATE LAMP
BLK
BLK/YEL
RIGHT LICENSE LAMP
BLK
88476W38

Fig. 119 Chassis wiring—1996 Pick-up (continued)

7

DRIVE TRAIN

MANUAL TRANSMISSION 7-2
CLUTCH 7-5
AUTOMATIC TRANSMISSION 7-7
TRANSFER CASE 7-9
DRIVELINE 7-10
FRONT DRIVE AXLE 7-12
REAR AXLE 7-17

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  - BACK-UP LIGHT SWITCH 7-2
    - REMOVAL & INSTALLATION 7-2
  - EXTENSION HOUSING SEAL 7-2
    - REMOVAL & INSTALLATION 7-2
  - TRANSMISSION 7-2
    - REMOVAL & INSTALLATION 7-2
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  - EXTENSION HOUSING SEAL 7-8
    - REMOVAL & INSTALLATION 7-8
  - TRANSMISSION ASSEMBLY 7-8
    - REMOVAL & INSTALLATION 7-8
- **TRANSFER CASE 7-9**
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    - LINKAGE 7-9
  - TRANSFER CASE 7-9
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SPECIFICATION CHART

- DRIVESHAFT PROBLEMS 7-20

MANUAL TRANSMISSION

Adjustments

SHIFT LINKAGE

➧ See Figure 1

➡The only manual transmission with adjustable gear shift linkage covered in this manual is the "Overdrive-4." The shift mechanism found on the other (later design) transmissions covered consists of a single unit, top mounted shift lever and internal mounted shift mechanism. Since the shift mechanism is internally mounted, no linkage adjustment is necessary.

1. Place the floorshift lever in Neutral. Insert a ¼ in. (6mm) drill bit through the bottom of the shifter to hold the levers in place.
2. Detach the shift rods. Make sure that the three transmission levers are in their Neutral detents.
3. Adjust the shift rods to make the length exactly right to fit into the transmission levers. Start with the 1st-2nd shift rod. It may be necessary to remove the clip at the shifter end of the rod to rotate this rod.
4. Replace the washers and the clips.
5. Remove the drill bit and check the shifting action.

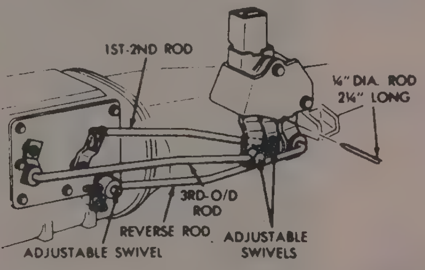


Fig. 1 Details of the shift linkage—Overdrive-4 (A833) transmission

Back-up Light Switch

REMOVAL & INSTALLATION

On all manual transmissions, the switch is located on the left side of the transmission just below and behind the shifter. It screws into place. Tighten it to 15 ft. lbs. (20 Nm).

Extension Housing Seal

REMOVAL & INSTALLATION

➡Special seal removal/installing tools are required. Use Remover No. C-3985 and Installer No. C-3972, or their equivalents.

1. Raise and support the vehicle.
2. Place a drain pan under the end of the extension housing.
3. Mark the position of the driveshaft and differential yoke for correct installation. Disconnect the driveshaft at the rear universal joint and carefully slide the shaft out of the transmission extension housing.
4. Remove the extension housing seal with the special tool.
5. Clean the end and inside of the extension housing. Start the new seal into position, with the installing tool, tap the seal into place.
6. Check the condition of the driveshaft slip yoke. Clean and sand with a crocus cloth to remove any minor nicks and rust.
7. Lubricate the lips of the seal and the slip yoke.
8. Align and install the driveshaft taking care when guiding the slip yoke into the extension housing.
9. Remove the drain pan. Check the transmission fluid level, add fluid if necessary. Lower the vehicle.

Transmission

REMOVAL & INSTALLATION

4-Speed 2WD Pick-Up and Ramcharger

1. Disconnect the negative battery cable. Remove the engine cover. Remove the gear shift lever and shift unit. Raise and support the vehicle. Drain the transmission fluid.
2. Mark the rear driveshaft yoke to differential for correct installation reference. Disconnect the rear universal joint and remove the driveshaft.
3. Disconnect the speedometer cable and back-up light switch electrical harness.
4. Support the rear of the engine. Remove the rear mount to crossmember bolts/nuts. Raise the rear of the engine slightly. Take care when raising the engine so nothing in the front of the engine, hoses lines, fan to radiator is strained or damaged.
5. Remove the rear transmission support crossmember. Position a suitable support jack under he transmission. Remove transmission to clutch bell housing retaining bolts and pull transmission rearward until drive pinion clears clutch, then remove transmission.
6. Place a small amount of Mopar® Multi-purpose Grease No. 4318063, or equivalent into clutch pilot bushing and on the clutch release bearing sleeve. Do not get any grease on the flywheel face. Do not lubricate the end of the transmission input shaft, clutch disc splines, or clutch release levers.
7. The remainder of installation is the reverse of removal. Tighten each component to specifications.
8. Install transmission to bell housing bolts, tightening to 50 ft. lbs. (68 Nm). Install the crossmember and tighten the mounting bolts to 30 ft. lbs. (41 Nm). Attach the rear transmission mount to the crossmember and tighten to 50 ft. lbs. (68 Nm).
9. Install gear shift unit and tighten the mounting bolts to 24 ft. lbs. (33 Nm). Install and adjust the shift linkage.
10. Install the driveshaft. Connect the speedometer cable and back-up light.
11. Install the transmission drain plug and fill the transmission with lubrication.
12. Install the shift lever and engine cover. Lower the vehicle. Connect the battery cable.

4-Speed 4WD Pick-Up and Ramcharger

1. Raise and support the truck.
2. Remove the skid plate, if any. Drain lubricant from the transmission and transfer case.
3. Disconnect the speedometer cable.
4. Disconnect and match-mark the front and rear driveshafts. Suspend each shaft from a convenient place; do not allow them to hang free.
5. Disconnect the shift rods at the transfer case. Remove the shift lever retainer by pressing down and turning it counterclockwise. Remove the shift lever springs and washers.
6. Remove the rear driveshaft. Matchmark the driveshaft and rear U-joints before removing the driveshaft.
7. Support the transfer case.
8. Remove the extension-to-transfer case mounting bolts.
9. Move the transfer case rearward to disengage the front input shaft spline.
10. Lower and remove the transfer case.
11. Disconnect the back-up light switch.
12. Support the engine.
13. Support the transmission.
14. Remove the transmission crossmember.
15. Remove the transmission-to-clutch housing bolts.
16. Slide the transmission rearward until the mainshaft clears the clutch disc.
17. Lower and remove the transmission.

18. The transmission pilot bushing in the end of the crankshaft requires high-temperature grease. Multi-purpose grease should be used. Do not lubricate the end of the mainshaft, clutch splines, or clutch release levers.
19. Raise and position the transmission.
20. Slide the transmission forward until the mainshaft enters the clutch disc, then push it all the way forward.
21. Install the transmission-to-clutch housing bolts. Tighten the bolts to 50 ft. lbs. (68 Nm).
22. Install the transmission crossmember.
23. Connect the back-up light switch.
24. Raise and position the transfer case. Move the transfer case rearward to disengage the front input shaft spline. Install the extension-to-transfer case mounting bolts. Tighten the bolts to 50 ft. lbs. (68 Nm).
25. The remainder of installation is the reverse of removal. Tighten each component to specifications.
26. Install the skid plate, if any. Fill the transmission and transfer case.
27. Lower the truck.

Pick-Up and Ramcharger With the NP2500 Transmission

1. Disconnect the negative battery cable. Remove the engine cover. Remove the upper shift lever. Raise and support the vehicle. Drain the transmission fluid.
2. Mark the rear driveshaft yoke to differential for correct installation reference. Disconnect the rear universal joint and remove the driveshaft.
3. If necessary, remove the exhaust system Y-pipe for clearance.
4. Disconnect the back-up light switch and distance sensor electrical harness. Separate the sensor from the speedometer adapter. Remove the speedometer components.
5. Support the rear of the engine. Remove the rear mount to crossmember bolts/nuts. Raise the rear of the engine slightly. Take care when raising the engine so nothing in the front of the engine, hoses lines, fan to radiator is strained or damaged.
6. Remove the rear transmission support crossmember. Position a suitable support jack under the transmission. Remove transmission to clutch bell housing retaining bolts and pull transmission rearward until drive pinion clears clutch, then remove transmission.

To install:

7. Place a small amount of Mopar® Multi-purpose Grease No. 4318-63, or equivalent into clutch pilot bushing and on the clutch release bearing sleeve. Do not get any grease on the flywheel face. Do not lubricate the end of the transmission input shaft, clutch disc splines, or clutch release levers.
8. Align clutch disc and backing plate with a spare drive pinion shaft or clutch aligning tool.
9. The remainder of installation is the reverse of removal. Tighten each component to specifications.

2WD Pick-Up With Getrag G-360 Transmission

➧ See Figures 2 thru 9

1. Disconnect the negative battery cable.
2. Remove the screws attaching the shift lever upper boot to the metal plate on the lower boot. Slide the boot upward on the lever.
3. Remove the screws attaching the lower boot and plate assembly to the floor pan.
4. Remove the shift lever extension by un-threading it from the shift lever.
5. Slide the lower boot and plate upward and off the shift lever.
6. Remove the transmission shift tower boot. Loosen the clamp securing the boot to the shift tower. Slide the boot up and off the shift lever and tower.
7. Remove the small shoulder-type alignment bolts at each side of the shift tower.
8. Remove the snapring securing the shift lever in the shift tower.
9. Remove the shift lever. If the lever doesn't come out readily, press the lever downward and quickly release it two or three times. Pressure from the spring under the lever should push it out of the housing.
10. Raise the vehicle and support it safely.
11. Mark the propeller shaft U-joints and axle yokes for assembly alignment reference.
12. Remove the propeller shaft. Remove the clamp strap bolts at the front of the shaft first. Remove the center bearing bracket bolts and support the shaft with a jackstand. Remove the rear clamp strap bolts and remove the shaft.
13. Unplug the distance sensor and back-up light switch connectors.

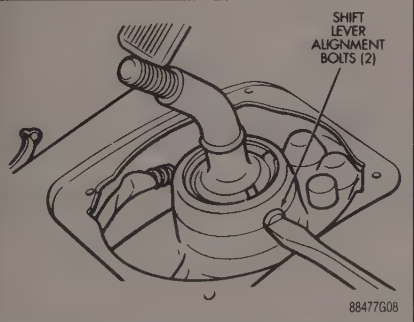


Fig. 2 Remove the shift lever alignment bolts as shown from the Getrag G-360 transmission

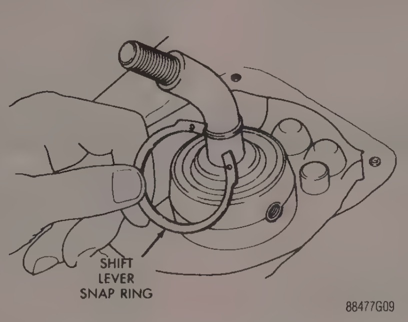


Fig. 3 Remove the snapring from the Getrag G-360 shifter

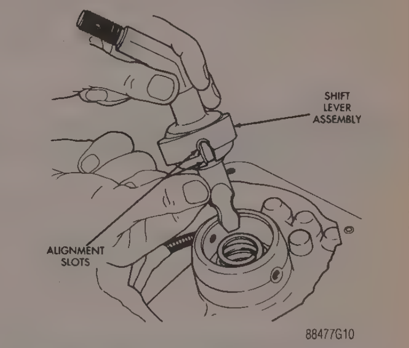


Fig. 4 Shift lever alignment slots on the Getrag transmission

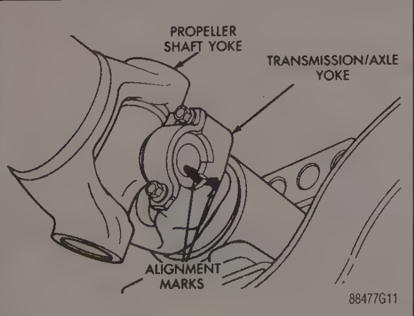


Fig. 5 Mark the driveshaft U-joints and axle yokes as shown for an assembly alignment reference

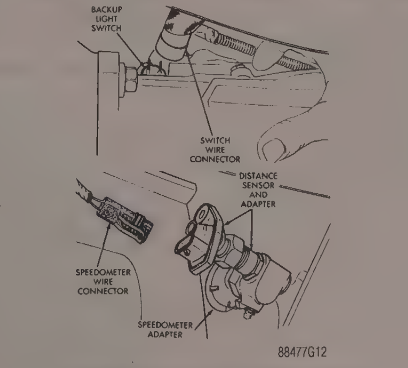


Fig. 6 Disengage the connectors shown from the G-360 transmission

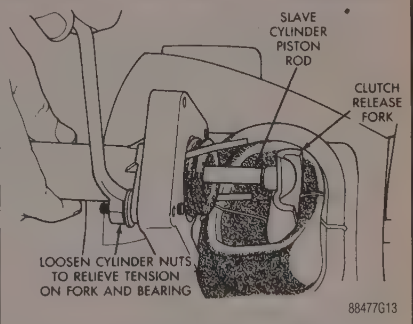

SLAVE CYLINDER PISTON ROD
CLUTCH RELEASE FORK
LOOSEN CYLINDER NUTS TO RELIEVE TENSION ON FORK AND BEARING
88477G13

Fig. 7 Loosen the slave cylinder nuts to reduce pressure on the release lever and bearing

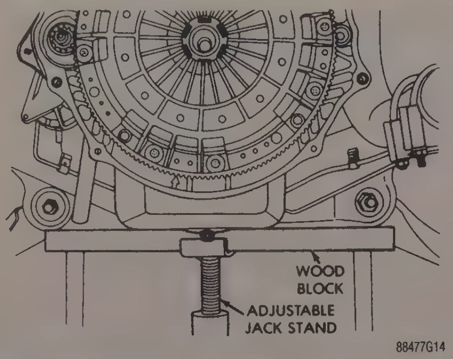


Fig. 8 Use a reliable method (as shown) to support the engine during transmission removal

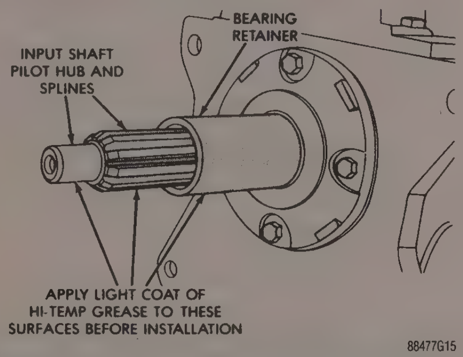


Fig. 9 Lubricate the input shaft at the locations indicated when installing the transmission

14. Spread the clamps securing the switch wires to the transmission top cover and remove the wires from the clamps. Move the wires aside.
15. Remove the bolts attaching the transmission rear mount to the crossmember.
16. Support the transmission with a suitable jack. Use a safety chain to secure the transmission to the jack.
17. Remove the screws attaching the fuel line clamps to the driver side frame rail. There are three of them.
18. Remove the left and right crossmember-to-frame braces, then remove the crossmember.
19. Remove the clutch slave cylinder shield.
20. Loosen the clutch slave cylinder attaching nuts until the cylinder piston rod is clear of the release lever. The cylinder does not have to be completely removed.
21. Remove the bolts attaching the transmission to the clutch housing and remove the transmission. Rock the transmission slightly to help free the input shaft from the clutch disc and release bearing. Support the engine with a wood block and adjustable jackstand.

To install:

22. Apply a light coating of Mopar® high temperature bearing grease to the transmission input shaft and release bearing slide surface of the front bearing retainer. Apply a light coating of grease to the bore of the release bearing.
23. Align the transmission and clutch housing. Move the transmission forward and start the input shaft into the release bearing and clutch disc hub.
24. Move the transmission forward and seat it against the housing.
25. Install and tighten the transmission mounting bolts to 50 ft. lbs. (68 Nm).
26. Install the rear crossmember and crossmember brackets. Start all crossmember bolts before tightening to 50 ft. lbs. (68 Nm).
27. Remove the transmission jack. The remainder of installation is the reverse of removal. Tighten each component to specifications.

4WD Pick-Up With Getrag G-360 Transmission

1. Disconnect the negative battery cable.
2. Remove the screws attaching the shift lever upper boot to the metal plate on the lower boot. Slide the boot upward on the lever.
3. Remove the screws attaching the lower boot and plate assembly to the floor pan.
4. Remove the shift lever extension by un-threading it from the shift lever.
5. Slide the lower boot and plat upward and off the shift lever.
6. Remove the transmission shift tower boot. Loosen the clamp securing the boot to the shift tower. Slide the boot up and off the shift lever and tower.
7. Remove the small should-type alignment bolts at each side of the shift tower.
8. Remove the snapring securing the shift lever in the shift tower.
9. Remove the shift lever. If the lever doesn't come out readily, press the lever downward and quickly release it two or three times. Pressure from the spring under the lever should push it out of the housing.
10. Raise the vehicle and support it safely.
11. Mark the front and rear propeller shafts for installation reference, then disconnect and remove both shafts.
12. Remove the transfer case skid plate and crossmember.
13. Disconnect the distance sensor and back-up light with connectors.
14. Disconnect the transfer case shift lever from the transfer case.
15. Support the transmission with an adjustable jackstand and support the transfer case with a transmission jack.
16. Remove the nuts attaching the transfer case to the transmission adapter. Lower the transfer case and move it from under the vehicle.
17. Move the adjustable jackstand from under the transmission and position it to support the engine.
18. Spread the clamps securing the switch wires to the transmission top cover and remove the wires from the clamps. Move the wires aside.
19. Remove the bolts attaching the transmission rear mount to the crossmember.
20. Support the transmission with a suitable jack. Use a safety chain to secure the transmission to the jack.
21. Remove the screws attaching the fuel line clamps to the driver side frame rail. There are three of them.
22. Remove the left and right crossmember-to-frame braces, then remove the crossmember.
23. Remove the clutch slave cylinder shield.
24. Loosen the clutch slave cylinder attaching nuts until the cylinder piston rod is clear of the release lever. The cylinder does not have to be completely removed.
25. Remove the bolts attaching the transmission to the clutch housing and remove the transmission. Rock the transmission slightly to help free the input shaft from the clutch disc and release bearing. Support the engine with a wood block and adjustable jackstand.

To install:

26. Apply a light coating of Mopar® high temperature bearing grease to the transmission input shaft and release bearing slide surface of the front bearing retainer. Apply a light coating of grease to the bore of the release bearing.
27. Align the transmission and clutch housing. Move the transmission forward and start the input shaft into the release bearing and clutch disc hub.
28. Move the transmission forward and seat it against the housing. Install and tighten the transmission mounting bolts to 50 ft. lbs. (68 Nm).
29. Install the rear crossmember and crossmember brackets. Start all crossmember bolts before tightening to 50 ft. lbs. (68 Nm).
30. Remove the transmission jack. The remainder of installation is the reverse of removal. Tighten each component to specifications. Tighten the transfer case attaching nuts to 35 ft. lbs. (47 Nm).

Pick-Up and Ramcharger With NV3500/4500

1. Disconnect the negative battery cable. Remove the upper shift lever. Raise and support the vehicle. Drain the transmission fluid.
2. Mark the rear driveshaft yoke to differential for correct installation reference. Disconnect the rear universal joint and remove the driveshaft.
3. 4WD vehicles: If necessary, remove the exhaust system Y-pipe for clearance.
4. Disconnect the back-up light switch and distance sensor electrical harness. Separate the sensor from the speedometer adapter. Remove the speedometer components.
5. Support the rear of the engine. Remove the rear mount to crossmember bolts/nuts. Raise the rear of the engine slightly. Take care when raising the engine so nothing in the front of the engine, hoses lines, fan to radiator is strained or damaged.

6. Remove the rear transmission support crossmember. Position a suitable support jack under the transmission. Remove transmission to clutch bell housing retaining bolts and pull transmission rearward until drive pinion clears clutch, then remove transmission.

To install:

7. Place a small amount of Mopar® Multi-purpose Grease No. 4318-63, or equivalent onto the following components:

- Drive gear splines and the pilot bearing hub
- Release bearing slide surface of the front retainer
- Pilot bearing
- Release bearing bore
- Release fork
- Release fork ball stud
- Driveshaft slip yoke

**** WARNING**

Do not get any grease on the flywheel face. Do not lubricate the end of the transmission input shaft, clutch disc splines, or clutch release levers.

8. Align clutch disc and backing plate with a spare drive pinion shaft or clutch aligning tool.

9. Raise the transmission into position. Slide the transmission forward until the input shaft is aligned with and starts to enter the clutch disc splines. With the transmission in gear, turn the splines until they are aligned then push the transmission in until it mates to the bell housing.

10. Install transmission to bell housing bolts. Install the crossmember. Attach the rear transmission mount to the crossmember.

11. Install the driveshaft. Connect the speedometer components. Install the distance sensor. Connect the back-up light.

12. If removed, install the exhaust system Y-pipe.

13. Install the transmission drain plug and fill the transmission with lubricant.

14. Install the upper shift lever and engine cover. Lower the vehicle. Connect the battery cable.

Dakota

1. Disconnect the negative battery cable.

2. Shift the transmission into Neutral and remove the upper shift lever.

3. Raise the vehicle and support safely. Remove the skid plate(s), if equipped. Drain the transmission lubricant.

4. Matchmark and remove the driveshaft(s).

5. Disconnect the wires from t he distance sensor, if equipped. Then loosen the sensor coupling and remove the sensor from the speedometer adaptor.

6. Disconnect the reverse light switch. Remove the transfer case, if equipped.

7. Install engine support fixture C-3487-A, or equivalent, to support the engine while the transmission is out of the vehicle. Raise the engine slightly with the support fixture.

8. Disconnect the insulator from the extension housing.

9. Using the proper equipment, support the transmission and remove the crossmember.

10. Remove the transmission to clutch housing bolts.

11. Slide the transmission rearward until the input shaft clears the clutch disc.

12. Pull the transmission completely away from the clutch housing and remove the transmission from the vehicle.

To install:

13. Lubricate the pilot bushing and input shaft splines very lightly with high temperature lubricant.

14. Mount the transmission securely on a suitable transmission jack and lift it is place until the input shaft is centered in the clutch housing opening. Roll the transmission forward until the input shaft splines fully engage with the clutch disc.

15. Install the transmission to clutch housing bolts. Tighten the bolts to 50 ft. lbs. (68 Nm).

16. Install the transmission crossmember. Remove the transmission and engine support fixtures.

17. Install the transfer case, if equipped and connect all linkage, electrical connectors and vacuum lines to the transfer case. The remainder of installation is the reverse of removal. Tighten each component to specifications.

18. Fill the transmission with the proper amount of 10W-30 engine oil with an API classification SG/CD. Fill the transfer case, if equipped, with the proper amount of Dexron®II lubricant.

19. Apply silicone sealer to the perimeter of the shifter base and install the shifter assembly.

20. Connect the negative battery cable and check the transmission for proper operation.

CLUTCH

Driven Disc and Pressure Plate

REMOVAL & INSTALLATION

Except Dakota

See Figures 10, 11, 12 and 13

1. Remove the transmission. Remove transfer case, if equipped.

2. Remove the clutch housing.

3. Remove the clutch fork and release bearing assembly.

4. Mark the clutch cover and flywheel, with a suitable tool or paint to assure correct reassembly.

5. Remove the pressure plate retaining bolts, loosening them evenly so the clutch cover will not be distorted.

6. Pull the pressure plate assembly clear of flywheel and, while the supporting pressure plate, slide the clutch disc from between flywheel and plate.

To install:

**** CAUTION**

Clutch discs may contain asbestos. Do NOT use compressed air to clean components. Instead, use a commercially available evaporative spray cleaner. Always use proper eye protection when working around spray chemicals.

7. Thoroughly clean all working surfaces of the flywheel and the pressure plate.

8. Grease radius at back of bushing.

9. Rotate clutch cover and pressure plate assembly for maximum clearance between flywheel and frame crossmember (if crossmember was not removed during clutch removal).

10. Tilt top edge of clutch cover and pressure plate assembly back and move it up into the clutch housing. Support clutch cover and pressure plate assembly, then slide clutch disc into position.

11. Position the clutch disc and the plate against the flywheel, then insert spare transmission main drive gear shaft or clutch installing tool through clutch disc hub and into main drive pilot bearing.

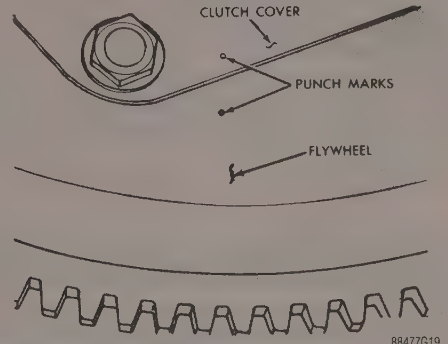


Fig. 10 Matchmark the clutch cover and flywheel

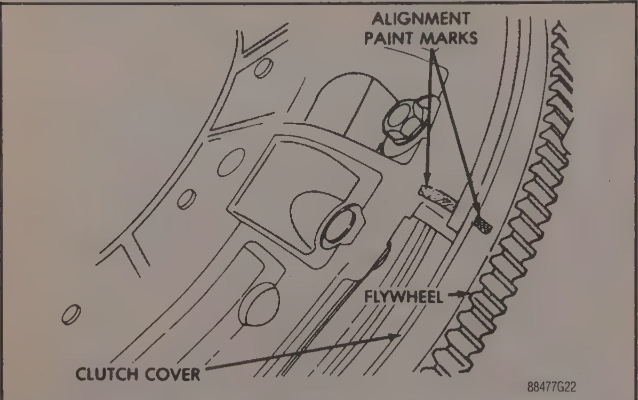


Fig. 11 Paint may be used to matchmark the clutch cover position

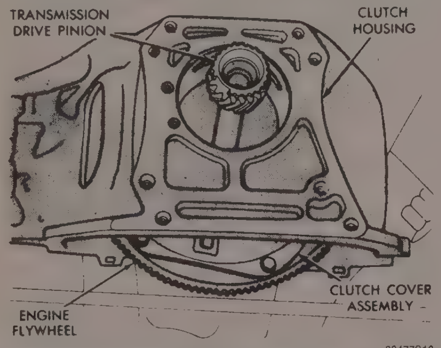


Fig. 12 Align the pilot bearing and the clutch disc with an alignment arbor tool, or equivalent

12. Rotate clutch cover until the punch marks on cover and flywheel line up.
13. Bolt the pressure plate loosely to flywheel. Tighten the bolts a few turns at a time, in progression, until tight. Then tighten bolts to:
    - 5⁄16 in. (8mm) bolts: 20 ft. lbs. (27 Nm)
    - 3⁄8 in. (10mm) bolts: 30 ft. lbs. (40 Nm)
14. Install transmission.
15. Install frame crossmembers and insulator, tighten all bolts.

Dakota

1. Disconnect the negative battery cable.
2. Raise the vehicle and support safely.
3. Remove the transmission and transfer case, if equipped.
4. Remove the inspection cover at the bottom of the bell housing.
5. Rotating the engine with a flywheel turner, remove the clutch cover bolts gradually as they appear.
6. Remove the clutch cover and disc by lowering it through the opening at the bottom of the housing.

To install:

7. Sparingly apply anti-seize compound to the input shaft and clutch disc splines. Install a new release bearing.
8. Raise the clutch cover and disc into place and use a suitable clutch aligning tool or spare input shaft to center the disc.

Tighten all of the bolts finger tight.

9. The cover bolts must be turned gradually, evenly and to the proper torque to avoid distorting the cover. Tighten the bolts to 21 ft. lbs. (28 Nm).
10. Install the transmission and transfer case, if equipped.
11. Install the inspection cover.
12. Connect the negative battery cable and check the clutch for proper operation.

Clutch Master Cylinder and Slave Cylinder

The hydraulic clutch master cylinder is mounted on the firewall and is fed fluid via gravity from a remote reservoir. The master cylinder mounting nuts are inside the cab. The torque for the nuts is 200 inch lbs. (22 Nm). Torque for the reservoir nuts is 95 inch lbs. (10 Nm). The slave cylinder is mounted on a bracket on the left side of the transmission. Mounting nut torque is 200 inch lbs. (22 Nm). The clutch master cylinder, remote reservoir, slave cylinder and connecting lines are serviced as an assembly only. The linkage components cannot be overhauled or serviced separately. The cylinders and connecting lines are filled and factory sealed.

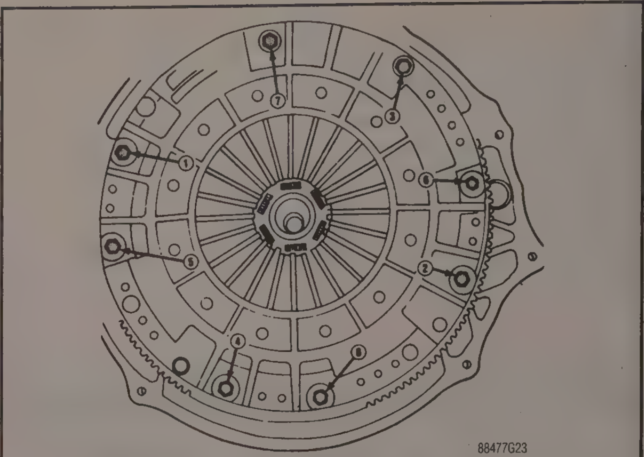


Fig. 13 Clutch cover bolt tightening/loosening sequence

REMOVAL & INSTALLATION

➧ See Figure 14

1. Disconnect the negative battery cable.
2. Raise the vehicle and support safely.
3. Remove the nuts attaching the slave cylinder to the bell housing.
4. Remove the slave cylinder and clip from the housing.
5. Lower the vehicle.
6. Remove the locating clip from the clutch master cylinder mounting bracket.
7. Remove the retaining ring, flat washer and wave washer that attach the clutch master cylinder pushrod to the clutch pedal. Slide the pushrod off of the pedal pin. Inspect the bushing on the pedal pin and replace if it is excessively worn.
8. Verify that the cap on the clutch master cylinder reservoir is tight so fluid will not spill during removal.
9. Remove the screws attaching the reservoir and bracket, if equipped, to the dash panel and remove the reservoir.
10. Pull the clutch master cylinder rubber seal from the dash panel.
11. Rotate the clutch master cylinder counterclockwise 45° to unlock it. Remove the cylinder from the dash panel.
12. Remove the clutch master cylinder, remote reservoir, slave cylinder and connecting lines from the vehicle.
13. Installation is the reverse of removal.
14. Operate the clutch pedal a few times to verify proper system operation. The system will self-bleed any air in and vent through the reservoir. Connect the negative battery cable and road test the vehicle.

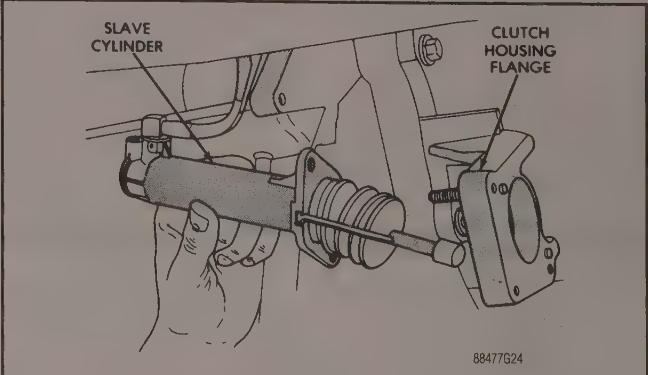


Fig. 14 The slave cylinder is mounted on the clutch housing flange

AUTOMATIC TRANSMISSION

Adjustments

FRONT (KICKDOWN) BAND

See Figure 15

The kickdown band adjusting screw is located on the left-hand side of the transmission case near the throttle lever shaft.

1. Loosen the locknut and back it off about five turns. Be sure that the adjusting screw turns freely in the case.
2. Tighten the adjusting screw to 72 inch lbs. (8 Nm).
3. Back off the adjusting screw to 2½ turns.
4. Hold the adjuster screw in position and tighten the locknut to 30 ft. lbs. (41 Nm).

REAR (LOW AND REVERSE) BAND

See Figures 16, 17 and 18

The pan must be removed from the transmission to gain access to the low and reverse band adjusting screw.

1. Drain the transmission fluid and remove the pan.
2. Loosen the band adjusting screw locknut and back it off about five turns. Be sure that the adjusting screw turns freely in the lever.
3. Tighten the adjusting screw to 72 inch lbs. (8 Nm).
4. Back off the adjusting screw as follows:
   - A727 & A518: 2 turns
   - A998 & A999: 4 turns
   - A-500: 4 turns
   - 42RH: 4 turns
   - 46RH: 2 turns
   - 47RH: 3 turns

   Keep the adjusting screw from turning, tighten and tighten the locknut to 25 ft. lbs. (34 Nm).
5. Use a new gasket and install the transmission pan.

SHIFT LINKAGE

See Figure 19

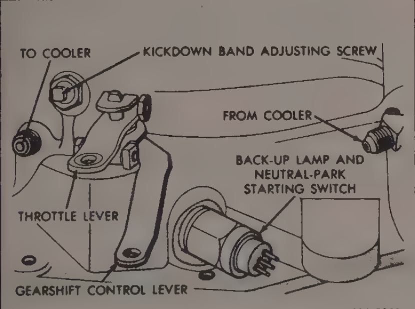
To insure proper adjustment, it is suggested that new linkage grommets be installed. Do not attempt to adjust the linkage if any of the parts are excessively worn. If any rods are removed from the plastic grommets, new grommets should be installed. Pry only where the grommet and rod attach, not on the rod itself. Use pliers to snap the rod into the new grommet.

1. Shift the transmission into Park.
2. Raise the vehicle and support safely.
3. Loosen the shift rod adjusting swivel lock screw. Make sure the swivel turns freely on the rod.
4. Make sure the valve body is in the Park position by moving it all the way rearward.
5. Adjust the swivel position on the shift rod to obtain a free pinfit in the torque shaft lever. Tighten the lock screw.
6. If the vehicle starts in any gear other than Park or Neutral, or does not start in both Park and Neutral, the either the adjustment is wrong or another problem exists.

THROTTLE LINKAGE

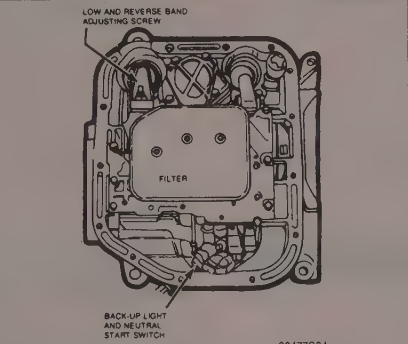
See Figure 20

1. Retract the ISC actuator by doing one of the following:
   a. If the DRBII scan tool is available, attach its connector to the diagnostic link-up. Start the engine and place the DRBII in the "Throttle Body Mini-


TO COOLER
KICKDOWN BAND ADJUSTING SCREW
FROM COOLER
BACK-UP LAMP AND NEUTRAL-PARK STARTING SWITCH
THROTTLE LEVER
GEARSHIFT CONTROL LEVER

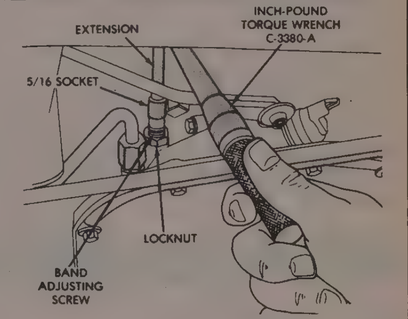
88477G33

Fig. 15 External controls and adjustment points for the A727/A999 transmission


LOW AND REVERSE BAND ADJUSTING SCREW
FILTER
BACK-UP LIGHT AND NEUTRAL START SWITCH

88477G34

Fig. 16 Low and reverse band adjusting screw

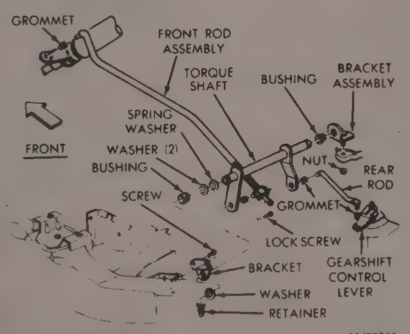

EXTENSION
INCH-POUND TORQUE WRENCH C-3380-A
5/16 SOCKET
LOCKNUT
BAND ADJUSTING SCREW

88477G36

Fig. 17 Use an inch lb. torque wrench to adjust the front band on the A-500 transmission

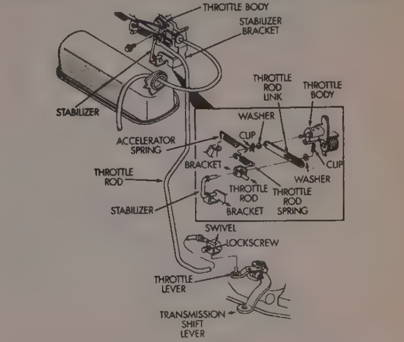
88477P13

Fig. 18 Use wrenches to adjust the rear (low and reverse) band calibration screw and locknut


GROMMET
FRONT ROD ASSEMBLY
TORQUE SHAFT
BUSHING
BRACKET ASSEMBLY
SPRING WASHER
FRONT
WASHER (2)
BUSHING
NUT
REAR ROD
SCREW
GROMMET
LOCK SCREW
BRACKET
GEARSHIFT CONTROL LEVER
WASHER
RETAINER

88477G38

Fig. 19 Details of a common column shift linkage


THROTTLE BODY
STABILIZER BRACKET
THROTTLE ROD LINK
THROTTLE BODY
STABILIZER
WASHER
CUP
ACCELERATOR SPRING
BRACKET
CUP
THROTTLE ROD
WASHER
THROTTLE ROD BRACKET
THROTTLE ROD SPRING
STABILIZER
SWIVEL
LOCKSCREW
THROTTLE LEVER
TRANSMISSION SHIFT LEVER

88477G37

Fig. 20 Details of the transmission throttle linkage

mum Air Flow Test" mode. Disconnect the electrical connector on the ISC actuator. Shut off the engine and disconnect the DRBII; the actuator is now fully retracted.

b. If the DRBII is not available, two jumper wires may be used. With the engine off, disconnect the connector to the ISC actuator. Connect a pair of jumper wires to the battery. Connect the negative jumper to the top pin of the ISC actuator and the positive jumper to the other pin. Do not leave the jumpers connected for more than five seconds. Disconnect the jumpers and the ISC actuator is fully retracted.

2. Raise the vehicle and support safely.
3. Loosen the adjustable swivel lock screw on the throttle rod enough so the rod travels freely in the swivel.
4. Hold the throttle lever firmly forward against its internal stop and tighten the lock screw. Lower the vehicle.
5. Reconnect the ISC actuator, if equipped.
6. Turn the ignition key to the **RUN** position for at least five seconds, but do not start the engine. Turn the key to the **OFF** position.
7. Start the engine and road test the vehicle.

Neutral Safety Switch

REMOVAL & INSTALLATION

See Figure 21

The neutral safely switch is thread mounted into the transmission case. When the gearshift lever is placed in either the Park or Neutral position, a cam, which is attached to the transmission throttle lever inside the transmission, contacts the neutral safety switch and provides a ground to complete the starter solenoid circuit. The back-up light switch is incorporated into the neutral safety switch. The center terminal is for the neutral safety switch and the two outer terminals are for the back-up lights. There is no adjustment for the switch. If a malfunction occurs, the switch must be removed and replaced. To remove the switch:

1. Disconnect the electrical leads and unscrew the switch. Use a drain pan to catch the transmission fluid.
2. Using a new seal, install the new switch and torque it to 24 ft. lbs. (32.5 Nm).
3. Pour four quarts of Dexron®II fluid through the filler tube.
4. Start the engine and idle it for at least 2 minutes.
5. Set the parking brake and move the selector through each position, ending in Park.
6. Add sufficient fluid to bring the lever to the FULL mark on the dipstick. The level should be checked in Park, with the engine idle at normal operating temperature.

Extension Housing Seal

REMOVAL & INSTALLATION

➡Special tool C-3985 Seal Remover and C-3995 or C-3972 Seal Installer, or their equivalents are required.

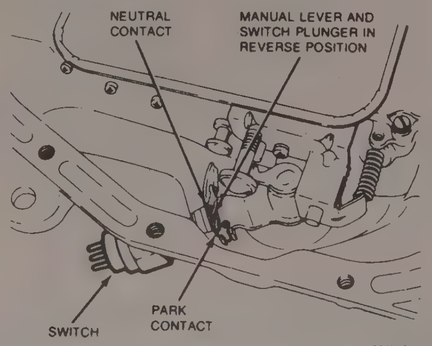


Fig. 21 The neutral safety switch is threaded into the transmission case

1. Raise and safely support the vehicle.
2. Place a suitable container under the extension housing end.
3. Mark the rear universal driveshaft yoke and differential for installation reference. Disconnect the rear universal joint and remove the driveshaft.
4. Remove the old extension housing seal using the special tool.
5. Clean the mounting surfaces of the extension housing.
6. Place the new seal into position and install it with the special tool by tapping it into place.
7. Lubricate the seal lips and slip yoke spline on the front of the driveshaft.
8. Install the driveshaft. Lower the vehicle and check the transmission fluid. Add fluid as necessary.

Transmission Assembly

REMOVAL & INSTALLATION

Pick-Up and Ramcharger

1. Remove the transmission and converter as an assembly; otherwise the converter drive plate pump bushing and oil seal will be damaged. The drive plate will not support a load. Therefore, none of the weight of transmission should be allowed to rest on the plate during removal.
2. Disconnect the negative battery cable. Remove the engine cover. Raise and safely support the vehicle.
3. Remove engine to transmission struts, if necessary. You may have to drop the exhaust system on some models.
4. Remove the starter. Remove wire from the neutral starting switch and converter solenoid (if equipped).
5. Remove the gearshift cable or rod from the transmission and the lever.
6. Disconnect the throttle rod from left side of transmission. Disconnect the distance sensor and speedometer.
7. Drain the transmission fluid and reinstall the pan.

Disconnect the oil cooler lines at transmission and remove the oil filler tube. Disconnect the speedometer cable.

8. Remove the converter front cover. Mark the converter and flexplate to converter mounting bolts/nuts. Turn the engine in a clockwise direction to gain access to the bolts. Mark for reference and remove the driveshaft.
9. Install engine support fixture or position a jack to hold up the rear of the engine. Care should be taken not to place strain on the radiator hoses, etc. Watch the fan-to-radiator clearance.
10. Position a suitable transmission jack under the transmission. Raise the transmission slightly with the jack to relieve load and remove support bracket or crossmember. Remove all of the bell housing bolts and carefully work transmission and converter rearward off engine dowels and disengage converter hub from end of crankshaft.

**** WARNING**

Attach a small C-clamp to edge of bell housing to hold converter in place during transmission removal; otherwise the front pump bushing might be damaged. Install transmission and converter as an assembly. The drive plate will not support a load. Do not allow the weight of transmission to rest on the plate during installation.

11. Using a jack, position transmission and converter assembly in alignment with engine.
12. Rotate converter so mark on converter (made during removal) will align with the mark on the flexplate. Carefully work the transmission assembly forward over engine block dowels with converter hub entering the crankshaft opening and the flexplate to converter mounts lined up.
13. Install converter housing to engine bolts and tighten them.
14. Install the converter to flexplate bolt. The remainder of installation is the reverse of removal. Tighten each component to specifications.

Dakota

1. Disconnect the negative battery cable.
2. Raise the vehicle and support safely. Drain the transmission and transfer case, if equipped.
3. Remove the exhaust crossover pipe.
4. Remove the skid plates, if equipped.

5. Matchmark and remove the driveshaft(s).
6. Disconnect the distance sensor, if equipped and the speedometer cable.
7. If equipped with 4WD, disconnect all linkage, electrical connectors and vacuum lines from the transfer case. Using a suitable jack, support the transfer case, unbolt the transfer case from the transmission and slide it backwards to remove it from the vehicle.
8. Remove the engine to transmission struts.
9. Remove the starter and the fluid cooler lines bracket.
10. Remove the torque converter inspection cover.
11. Matchmark the converter to the flex plate. Remove the torque converter bolts.
12. Disconnect the wires to the neutral safety switch and lock-up solenoid, if equipped.
13. Disconnect and plug the oil cooler lines from the transmission.
14. Disconnect the gearshift rod and torque shaft assembly from the transmission.
15. Disconnect the throttle rod from the lever.
16. Unbolt the oil filler tube brace and lift the oil filler tube out of its bore.
17. Install an appropriate engine support fixture to hold the engine in place when the transmission is out of the vehicle.
18. Raise the transmission slightly using a suitable transmission jack.
19. Remove the transmission crossmember.
20. Remove the oil filter, if necessary. Remove all bell housing bolts and remove the transmission from the vehicle.
21. Installation is the reverse of removal. Install the bell housing bolts and tighten to 30 ft. lbs. (41 Nm). Install the oil filter, if it was removed.
22. Install the torque converter bolts and tighten to 23 ft. lbs. (31 Nm). Connect the oil cooler lines.
23. Fill the transmission with the proper amount of Dexron®II.
24. Road test the vehicle, check for leaks and recheck the fluid level.

TRANSFER CASE

Adjustments

LINKAGE

New Process 205

1. Shift the transfer case into Neutral.
2. Move the shift rod boot upward for access.
3. Loosen the shift bracket bolts and move the bracket as far forward as possible. Tighten the bolts.
4. Check the smoothness of operation of the transfer case.

New Process 231 and 241

➧ See Figures 22 and 23

➡This procedure is identical for all years except that earlier models (1989–93) require a different shift position than the later models (1994–96) when performing the standard adjustment procedure.

1. Move the transfer case shift lever boot aside for access to the shift lever and gate.
2. On 1989–93 models, move the shift lever into the 4H position. Make sure the lever is against the 4H gate.
3. On 1994–96 models, move the shift lever into the 2H position. Make sure the lever is against the 2H gate.
4. Raise the vehicle and support safely.
5. Loosen the shift rod clamp screw until the shift rod is free to slide in the swivel.
6. Verify that the lever is in the 4H (1989–93 models) or 2H (1994–96 models) position and move it if it has moved out of position.
7. Tighten the lock bolt to 90 inch lbs. (10 Nm).
8. Lower the vehicle.
9. Check the smoothness of operation of the transfer case.

Transfer Case

REMOVAL & INSTALLATION

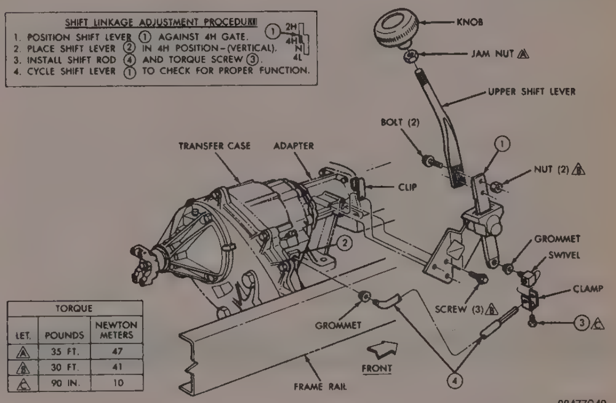
Pick-Up and Ramcharger

➧ See Figures 24, 25 and 26

1. Raise and support the truck.
2. Remove the skid plate, if equipped.
3. Drain the transfer case by removing the bottom bolt from the front output rear cover.
4. Disconnect the speedometer cable.
5. Disconnect the front and rear output shafts. Suspend these from a convenient location; do not allow them to hang free.
6. Disconnect the shift rods at the transfer case.
7. Support the transfer case.
8. Remove the adapter-to-transfer case mounting bolts and move the transfer case rearward to disengage the front input splines.
9. Lower and remove the transfer case.
10. Installation is the reverse of removal. Adjust the linkage.

Dakota

1. Disconnect the negative battery cable.
2. Raise the vehicle and support safely.
3. Remove the skid plates, if equipped. Drain the transfer case fluid.
4. Disconnect the distance sensor, if equipped and disconnect the speedometer cable from the transfer case.



SHIFT LINKAGE ADJUSTMENT PROCEDURE
1. POSITION SHIFT LEVER ① AGAINST 4H GATE.
2. PLACE SHIFT LEVER ② IN 4H POSITION–(VERTICAL).
3. INSTALL SHIFT ROD ④ AND TORQUE SCREW ③.
4. CYCLE SHIFT LEVER ① TO CHECK FOR PROPER FUNCTION.

TORQUE		
LET.	POUNDS	NEWTON METERS
A	35 FT.	47
B	30 FT.	41
C	90 IN.	10

Fig. 22 Shift linkage adjustment procedure and exploded view of the NP-241 shift linkage

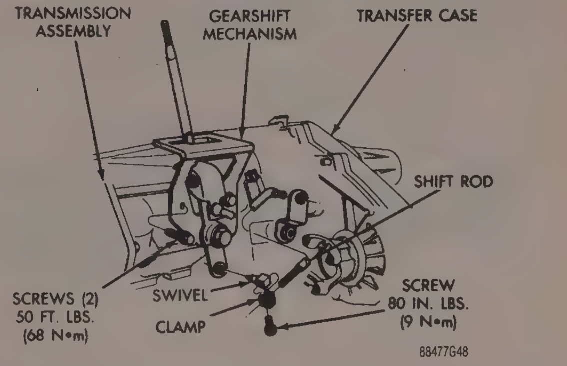


Fig. 23 Details of the NP-231 transfer case shifter mechanism

5. Matchmark and remove the driveshafts.
6. Disconnect the Power Take-Off (PTO), if equipped.
7. Disconnect the linkage, electrical connectors and vacuum lines from the transfer case. Using a suitable jack, support the transfer case and remove the crossmember.
8. Unbolt the transfer case from the transmission and slide it backward to remove it from the vehicle.
9. The installation is the reverse of the removal procedure. Tighten the transfer case to transmission case nuts to 26 ft. lbs. (35 Nm). Fill the transfer case with Dexron®II.

88477P03

Fig. 24 Unbolt the skid plate from the transfer case, if equipped

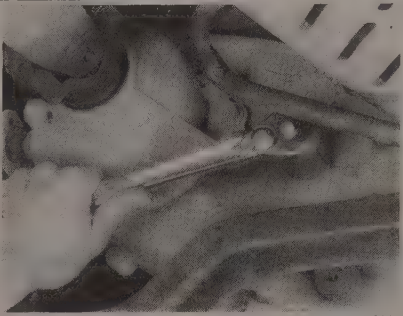

88477P04

Fig. 25 Once the transfer case is installed, remove the plug with a suitable wrench or ratchet and socket

88477P05

Fig. 26 Always fill the transfer case with the specified lubricant for your vehicle

DRIVELINE

Front Driveshaft and U-joints

REMOVAL & INSTALLATION

➧ See Figure 27

1. Remove the four flange retaining bolts and lockwashers from the constant velocity U-joint at the transfer case. Mark the parts to reinstall them in the same position. To prevent the constant velocity joint from turning while remove the nut, use a press bar.
2. Remove the nuts and lockwashers from the U-bolts at the differential flange and remove the U-bolts.
3. Support the driveshaft and separate the U-joint at the front the driveshaft yoke, pulling backward to clear the flange. The driveshaft should never be allowed to hang by either universal joint.
4. Remove the driveshaft.
5. Installation is the reverse of removal.

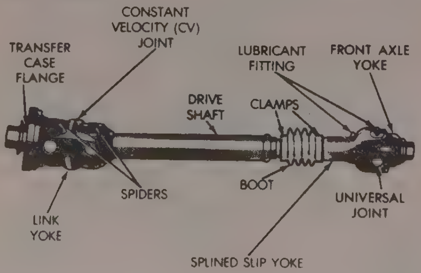
Rear Driveshaft and U-Joints

REMOVAL & INSTALLATION

One-Piece Driveshaft

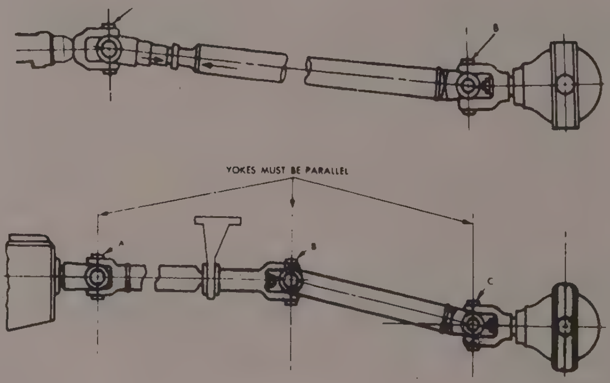
➧ See Figures 28 and 29

1. Raise the vehicle and support safely.
2. Matchmark the driveshaft and the rear axle drive pinion gear shaft yoke.
3. Remove the rear U-joint attaching bolts and both strap clamps from the rear axle drive gear shaft yoke.
4. Fluid may run from the rear of the extension housing or transfer case when the shaft is removed, so position a suitable drain pan under the area.
5. Remove the driveshaft from the transmission or transfer case.
6. The installation is the reversal of the removal procedure. Tighten ¼ – 28 clamp bolts to 14 ft. lbs. (19 Nm) and 5/16 – 24 to 25 ft. lbs. (34 Nm).



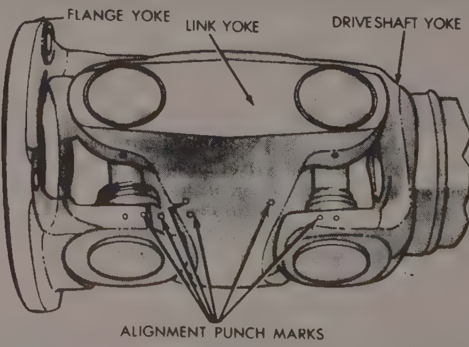
88477G53

Fig. 27 Details of the common 4WD front driveshaft assembly



88477G51

Fig. 28 Alignment points for the 2-piece (and 1-piece) driveshaft



88477G58

Fig. 29 Matchmark the link yoke as shown for correct alignment upon reinstallation

Two-Piece Driveshaft

▶ **See Figures 28, 29 and 30**

➡This driveshaft has a universal joint at either end, with a third universal joint and a support bearing at the center.

1. Matchmark the shaft and the rear axle pinion hub yoke. Matchmark the center bearing spline and slip yoke.

➡Do not allow the driveshaft to hang down the during removal. Suspend it from the frame. Raise the rear of the truck to prevent loss of transmission fluid.

2. Remove both rear U-joint roller and bushing assembly clamps from the rear axle pinion yoke. Do not disturb the retaining strap used to hold the bushing assemblies on the U-joint cross.
3. Slide the rear half of the shaft off the front shaft splines at the center bearing. Remove the rear half.
4. At the transmission end of the front half, remove the bushing retaining bolts and clamps, after matchmarking. If there is a driveshaft brake, there will be flange nuts.
5. Unbolt the center bearing mounting nuts and bolts and remove the front half of the shaft.

To install:

6. Align the matchmarks at the transmission and start all the bolts and nuts at the front U-joint and the center support bearing.
7. Tighten 1/4 in. clamp bolts to 170 inch lbs. (19 Nm) and 5/16 in. bolts to 300 inch lbs. (34 Nm). Tighten driveshaft brake flange nuts to 35 ft. lbs. (47 Nm). Leave the center bearing bolts just snug.
8. Align the rear U-joint matchmarks and install the bushing clamps and bolts. Tighten the bolts to the torque given in Step 7. Grease the joints and splines.
9. Jack up the rear wheels and let the engine drive the shaft. The center support bearing will align itself.
10. Tighten the center bearing bolts to 50 ft. lbs. (68 Nm).

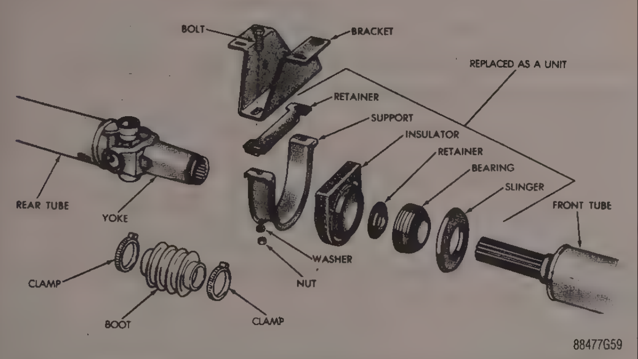


Fig. 30 Exploded view of the halfshafts, center bearing and mounting bracket

U-JOINT REPLACEMENT

Single Cardan Universal Joint

▶ **See Figure 31**

1. Remove the driveshaft and slip yoke, if equipped from the vehicle.

➡Do not clamp the driveshaft tube in a vise. Clamp only the forged portion of the welded yoke or the slip yoke in a vise. Do not overtighten the vise jaws.

2. Clamp the yoke in a vise and remove the bearing cap retainers.
3. Place a socket which has an inside diameter larger than the outside diameter of the bearing cap, against the yoke around the perimeter of the first cap to be removed. Place a socket which is slightly smaller than the cap, on the cap, opposite the cap to be removed. Then position the yoke in a vise.
4. Compress the jaws until the smaller socket has driven the other cap into the larger socket.

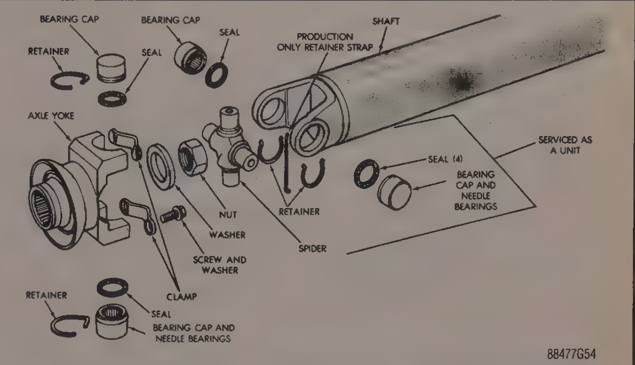


Fig. 31 Exploded view of a single cardan-type U-joint assembly at the fixed yoke

5. Release the jaws and remove the cap that is partially out of the yoke.
6. Repeat the procedure for the remaining cap(s).

To install:

7. Clean and remove and rust from the yoke bores and lubricate lightly with suitable lithium based grease.
8. Position the spider cylinders in the yoke bores. Insert the seals into the yoke bore and against the spider cylinders. Tap the bearing caps into the yoke bores far enough to keep the spider in place.
9. Place the socket that is slightly smaller than the cap against the first cap and position the assembly in a vise.
10. Compress the jaws to force the bearing caps into the yoke bores far enough so the retainer grooves are visible.
11. Repeat the procedure for the remaining caps if necessary.
12. Install the retaining clips.
13. Install the driveshaft assembly to the vehicle.

Double Cardan Constant Velocity Joint

▶ **See Figures 32, 33 and 34**

1. Remove the front driveshaft from the vehicle.
2. Matchmark the yokes before disassembling so they will be installed in their original locations to retain driveshaft balance.
3. To expedite removal, remove the bearing caps in the sequence indicated.
4. Support the driveshaft horizontally and aligned with the base plate of the press. Shear the bearing cap plastic retaining ring and position the first link yoke rear arm over a 1⅛ in. (29mm) socket. Place Spider Press Tool C-4365-1, or equivalent, on the bearing caps in the flange yoke arms. Force the bearing caps out of the yoke with a press.
5. If the bearing cap is not completely removed, insert a suitable spacer between the spider and bearing cap and complete the removal.
6. Rotate the driveshaft 180° and repeat the procedure.
7. Disengage the spider trunnions from the link yoke. Pull the flange yoke and the spider from the centering ball on the ball support tube yoke.
8. To remove the ball socket, separate the CV-joint between the link yoke and the flange yoke by forcing the spider trunnion bushing from the link yoke. Pull the flange yoke and the spider with the ball socket from the centering ball as an assembly.
9. Pry the seal from the ball socket and remove the washers, spring and 3 ball seats.

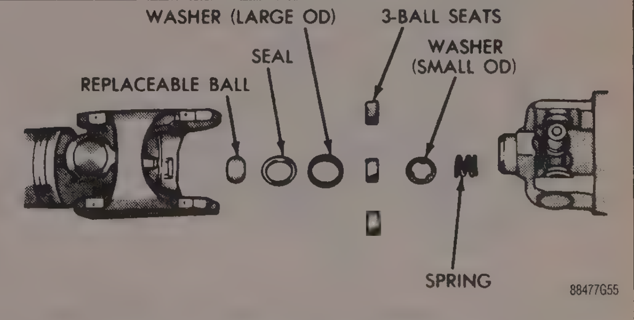


Fig. 32 Exploded view of a double cardan-type CV-joint

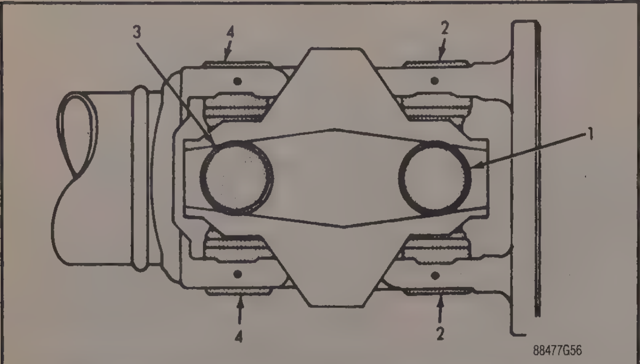

3
4
2
1
4
2
88477G56

Fig. 33 Removal sequence for the bearing cap—double cardan-type CV-joint

10. Remove the centering ball from the ball socket using Tool set C-4365, or equivalent.

To install:

11. Install the centering ball in the socket using special tool C-4365-3, or equivalent. Force the ball into the socket until it is seated firmly against the shoulder at the base of the socket.
12. To install the spider, insert one bearing cap partially into on of the yoke bores and then rotate the yoke 180°. Insert the spider into the yoke bore and seat the spider trunnion in the bearing cap. Partially insert the opposite bearing cap in the remaining yoke bore.
13. Force the bearing caps inward while pivoting the spider back and forth to provided free movement of the trunnions in the bearing.

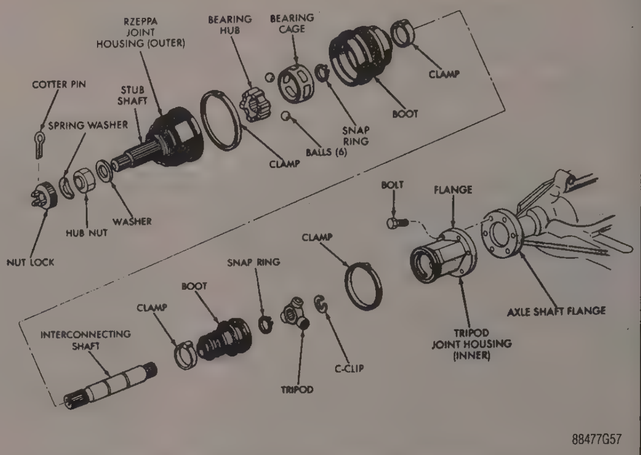

RZEPPA JOINT HOUSING (OUTER)
BEARING HUB
BEARING CAGE
COTTER PIN
STUB SHAFT
SPRING WASHER
CLAMP
BOOT
SNAP RING
BALLS (6)
CLAMP
WASHER
HUB NUT
NUT LOCK
BOLT
FLANGE
CLAMP
SNAP RING
BOOT
CLAMP
INTERCONNECTING SHAFT
TRIPOD
C-CLIP
TRIPOD JOINT HOUSING (INNER)
AXLE SHAFT FLANGE
88477G57

Fig. 34 Exploded view of the CV driveshaft components—Dakota models

14. When the retainer grooves become visible, install the retainer.
15. Continue to force the caps inward until the opposite retainer can be installed in its groove.
16. Lubricate the centering ball and socket with the lubricant provided in the replacement kit.
17. Repeat the installation procedure with the remaining portion of the assembly.

FRONT DRIVE AXLE

Hubs and Bearings

REMOVAL & INSTALLATION

Models 44, 60, 70 and 80 with Manual or Automatic Locking Hubs

➧ See Figures 35 and 36

1. Raise the vehicle and install jackstands.
2. Refer to Manual or Automatic Free Running Hub Removal and Installation and remove the hub assemblies.
3. Remove the wheel bearing lock nut, using a hub nut wrench.
4. Remove the lock ring from the bearing adjusting nut. This can be done with your finger tips or a screwdriver.
5. Using a hub nut wrench remove the bearing adjusting nut.
6. Remove the caliper and suspend it out of the way (see the brake section).
7. Slide the hub and disc assembly off the spindle. The outer wheel bearing will slide out as the hub is removed, so be prepared to catch it.

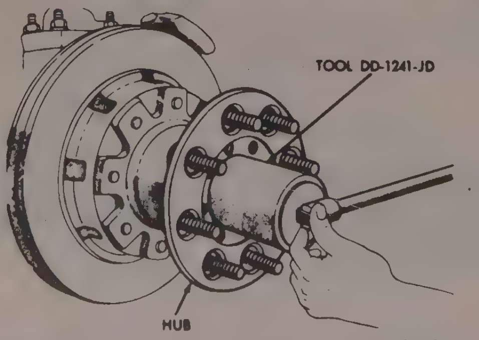

TOOL DD-1241-JD
HUB
88477G63

Fig. 35 Remove the outer locknut on the Model 60/70 front drive axle

To install:

8. Carefully position the hub and disc assembly on the spindle.
9. Install the outer bearing cone and roller, and the adjusting nut.

➡The adjusting nut has a small dowel on one side. This dowel faces outward to engage the locking ring.

10. Using a hub nut wrench tighten the bearing adjustment nut to 50 ft. lbs. (68 Nm), while rotating the wheel back and forth to seat the bearings.
11. Back off the adjusting nut approximately 90°.
12. Install the lock ring by turning the nut to the nearest hole and inserting the dowel pin.

➡The dowel pin must seat in a lock ring hole for proper bearing adjustment and wheel retention.

13. Install the outer lock nut and tighten to 50–80 ft. lbs. (68–108 Nm). Final end-play of the wheel on the spindle should be 0.001-0.010 in. (0.025-0.25mm).
14. Assemble the hub parts.
15. Install the caliper.
16. Remove the jackstands and lower the vehicle.

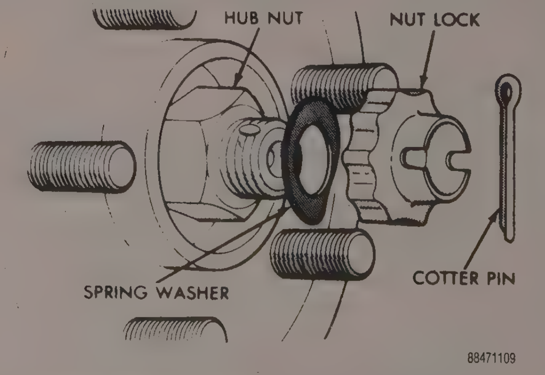

HUB NUT
NUT LOCK
COTTER PIN
SPRING WASHER
88471109

Fig. 36 Exploded view of the front hub retaining hardware

Model 44 With Full-Time 4-Wheel Drive

See Figures 37, 38 and 39

1. Remove the wheel cover.
2. Remove the cotter pin and loosen the axle shaft nut.
3. Raise the support the front end on jackstands.
4. Remove the wheels.
5. Unbolt the caliper and support it out of the way. DO NOT DISCONNECT THE BRAKE LINE!
6. Remove the inboard brake pad.
7. Remove the axle shaft nut and washer.
8. Through the hole provided in the rotor, remove the six retainer bolts.
9. Position pull C-4358, or equivalent, over the wheel lugs and install the lug nuts. Tighten the main screw of the puller to remove the hub, bearings, retainer and outer seal as an assembly.
10. Insert a prybar through the U-joint and wedge the shaft inward as far as it will go. Make sure that it is wedged securely and can't be moved.
11. Install the hub, rotor and bearing assembly and tighten the retainer bolts to 30 ft. lbs. (40 Nm) in a crisscross pattern.
12. Install the brake adapter. Tighten the bolts to 85 ft. lbs. (115 Nm).
13. Remove the prybar form the U-joint.
14. Install the axle shaft nut and tighten it to 100 ft. lbs. (136 Nm), then continue tightening it to align the cotter pin holes. Install the cotter pin.
15. Using the lube fitting, fill the knuckle with NLGI, Grade 2, multi-purpose EP grease until the grease is seen flowing through the inner seal.
16. Install the inner brake pad and caliper (see Section 9).
17. Install the wheels and tighten the lug nuts to 110 ft. lbs. (150 Nm).

Halfshaft

REMOVAL & INSTALLATION

Dakota

1. Disconnect the negative battery cable.
2. Raise the vehicle and support safely.
3. Remove the tire and wheel assembly.
4. Remove the cotter pin form the end of the halfshaft. Remove the nut lock, spring washer, axle nut and washer.
5. Remove the ball joint retaining bolt and pry the control arm down to release the ball stud from the steering knuckle.
6. Position a drain pan under the transaxle where the halfshaft enters the differential or extension housing. Remove the halfshaft from the transaxle where the halfshaft enters the differential or extension housing. Remove the halfshaft from the transaxle or center bearing. Unbolt the center bearing from the block and remove the intermediate shaft from the transaxle, if equipped.

To install:

7. Install the halfshaft or intermediate shaft to the transaxle, being careful not to damage the side seals. Make sure the inner joint clicks into place inside the differential. Install the outer shaft to the center bearing if equipped. Install the outer shaft to the center bearing if equipped.
8. The remainder of installation is the reverse of removal. Tighten each component to specifications.
9. Install the axle nut washer and nut and tighten the nut to 180 ft. lbs. (244 Nm). Install the spring washer, nut lock and a new cotter pin.

Axle Shaft, Bearing and Seal

REMOVAL & INSTALLATION

Model 44

LEFT SIDE AXLE SHAFT

See Figures 40, 41, 42 and 43

1. Raise and support the front end on jackstands.
2. Remove the wheel.
3. Remove the caliper and support it up and out of the way. DO NOT DISCONNECT THE BRAKE LINE!
4. Remove the inboard brake pad.
5. Remove the hub-rotor assembly.
6. Unbolt and remove the splash shield and spindle from the knuckle. It may be necessary to tap the spindle loose with a soft mallet.
7. Disconnect the vacuum lines and wire at the disconnect housing on the axle.
8. Remove the disconnect housing cover, gasket and shield.
9. Carefully pull the intermediate shaft through the seal and out of the axle housing.
10. Remove the shift collar from the disconnect housing.

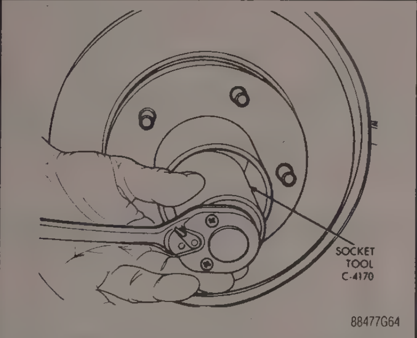


Fig. 37 Remove the wheel bearing adjusting nut from the Model 44 front axle

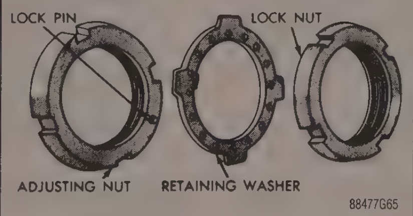


Fig. 38 Exploded view of the Model 44 wheel bearing adjusting nut, retaining washer and locknut in their correct relationship

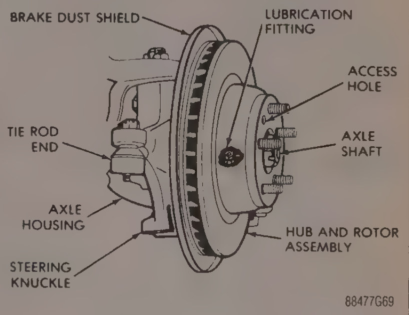


Fig. 39 Lubrication fitting location on the rotor top hat

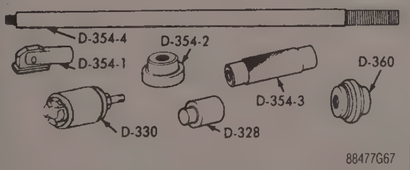


Fig. 40 Special tools required for axle housing service

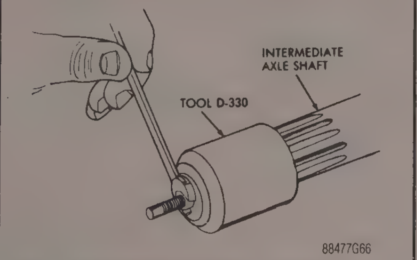


Fig. 41 Remove the bearing from the intermediate shaft using the special tool

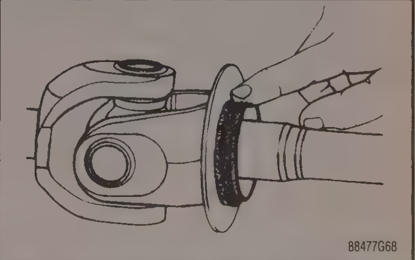


Fig. 42 Lubricate the lip seal with multi-purpose chassis grease

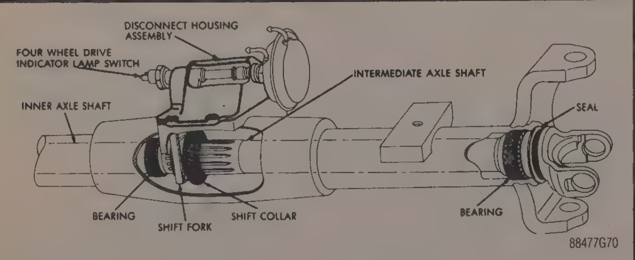


Fig. 43 Details of the axle housing assembly

11. Drive out the inner axle shaft seal and remove it from the disconnect housing. Discard the seal.

➡Some axles may have a seal guard. Replacement seals do not use a guard.

12. Remove the needle bearing from the intermediate shaft using tool D-330 or equivalent.
13. Remove the differential cover. Allow the oil to drain into a drain pan.
14. While pushing inward on the inner shaft, remove the C-lock from the groove on the shaft.
15. Remove the inner shaft with tools D-354-4 and adapter D-354-3 or equivalents.
16. Remove the bearing from the inner shaft with tools D-354-4, D-354-1 and C-637, or equivalents.
17. Thoroughly clean and inspect all parts. Replace any worn or damaged parts.

To install:

18. Using tools D-354-4, D-354-2 and C-637 or equivalents, install a new bearing on the inner shaft.
19. Position the inner shaft in the axle housing using tools D-354-4 and adapter D-354-3, or equivalents.
20. Carefully slide the shaft into position and install the C-lock.
21. Place a new axle shaft seal on tool D-5041-1 and position the assembly in the disconnect housing. Screw threaded bar 5041-2 through the seal and into tool 5041-1. Place tool 5041-3 and the nut on the end of the bar and tighten the nut until the tool reaches the shoulder of the bar.
22. Install the shift collar onto the splined end of the inner shaft.
23. Using tool D-328 and handle C-4171 or equivalents, install the needle bearing into the intermediate shaft.
24. Coat the splined end of the intermediate shaft with multi-purpose chassis lube and install it through the inner axle seal. Avoid damage to the seal!
25. Install the disconnect housing cover and gasket. Make sure that the shift fork indexes the groove in the shift collar. Tighten the cover bolts to 10 ft. lbs. (14 Nm).
26. The remainder of installation is the reverse of removal. Tighten each component to specifications.

RIGHT SIDE AXLE SHAFT

1. Raise and support the front end on jackstands.
2. Remove the wheel.
3. Remove the caliper and support it up and out of the way. DO NOT DISCONNECT THE BRAKE LINE!
4. Remove the inboard brake pad.
5. Remove the hub-rotor assembly.
6. Unbolt and remove the splash shield and spindle from the knuckle. It may be necessary to tap the spindle loose with a soft mallet.
7. Remove the caliper adapter from the knuckle.
8. Carefully pull the axle shaft from the housing.
9. Thoroughly clean and inspect all parts. Replace any worn or damaged parts. The axle U-joint can be rebuilt in the same manner as a driveshaft U-joint, as previously described.
10. Installation is the reverse of removal.

Models With Full-Time 4-Wheel Drive

➧ See Figure 44

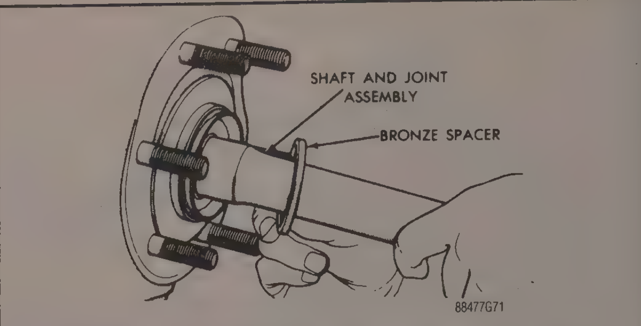


Fig. 44 Remove the Model 60 shaft and joint from the hub assembly

1. Remove the wheel cover.
2. Remove the cotter pin and loosen the axle shaft nut.
3. Raise and support the front end on jackstands.
4. Remove the wheels.
5. Unbolt the caliper and support it out of the way. DO NOT DISCONNECT THE BRAKE LINE!
6. Remove the inboard brake pad.
7. Remove the axle shaft nut and washer.
8. Through the hole provided in the rotor, remove the six retainer bolts.
9. Position puller C-4358, or equivalent, over the wheel lugs and install the lug nuts. Tighten the main screw of the puller to remove the hub, bearings, retainer and outer seal as an assembly.
10. Remove the puller.
11. Remove the caliper adapter from the knuckle.
12. Place a pry bar behind the inner axle shaft yoke and push the bearings out of the knuckle.
13. Some knuckles have and O-ring. If so, remove and discard it.
14. Carefully pull the axle shaft from the axle. Remove the seal and slinger from the shaft.
15. The U-joint can now be disassembled in the same manner as a driveshaft U-joint, explained earlier in this section.

To install:

16. If you removed the brake dust shield, install it now. Tighten the mounting bolts to 15 ft. lbs. (20 Nm).
17. Apply RTV silicone sealer to the sealing surfaces of the axle shaft.
18. Using a driver, install the slinger onto the shaft.
19. Install a new seal on the slinger with the lip toward the splines.
20. Carefully insert the shaft into the axle housing, being careful to avoid damage to the differential side gear seal.
21. Insert a prybar through the U-joint and wedge the shaft inward as far as it will go. Make sure that it is wedged securely and can't be moved.
22. Using adapter tool C-4398-2 and driver, or equivalents, install the seal cup in the knuckle until it is bottomed. A small amount of wheel bearing grease on the adapter will help hold the cup in position. Leave the tool in position for the time being.
23. Apply a ¼ in. (6mm) bead of RTV sealant to the retainer face on the chamfer.
24. Carefully remove the seal installing tool so that the outer shaft remains centered.

➡If the shaft is touched, make sure that the seal lip is still riding inside the cup.

25. The remainder of installation is the reverse of removal. Tighten each component to specifications.
26. Using the lube fitting, fill the knuckle with NLGI, Grade 2, multi-purpose grease until the grease is seen flowing through the inner seal.
    a. Remove the grease gun and rotate the hub several times.
    b. Install the grease gun and continue filling the knuckles until grease appears around at least 50 percent of the seal circumference.

Chrysler 7¼ In. (184mm) Axle

LEFT SIDE SHAFT

➧ See Figures 45, 46, 47 and 48

1. Raise the vehicle and support safely.
2. Disconnect the left CV driveshaft from the axle shaft flange.
3. Remove the differential housing cover. Rotate the differential case so that the differential pinion mate gear shaft lock screw is accessible. Remove the lock screw and the pinion mate gear shaft from the differential case.

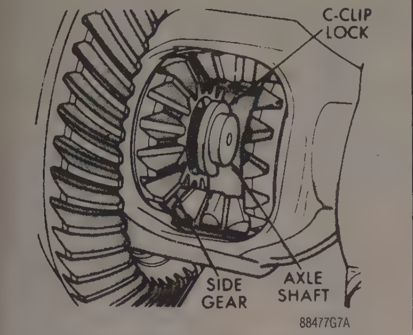


Fig. 45 Remove the C-clip retaining the axle shaft

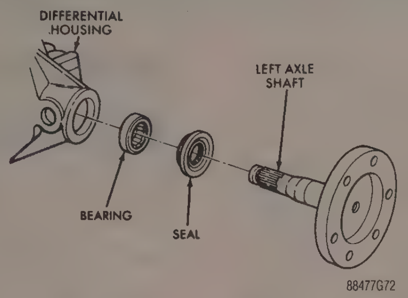


Fig. 46 Exploded view of the left axle shaft, seal and bearing on the 7¼ in. axle

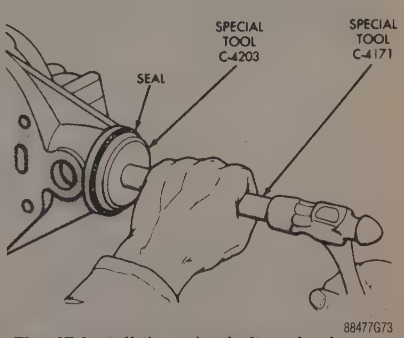


Fig. 47 Install the axle shaft seal using a hammer and special driver, or equivalent

4. Force the left axle shaft toward the center of the vehicle and remove the shaft C-clip lock from the recessed groove in the axle shaft.
5. Remove the axle shaft from the differential housing. Inspect the axle shaft bearing contact surface for brinelling, spalling and pitting. If any of these conditions exist, replace the axle shaft and bearing.
6. Remove the axle shaft seal from the end of the housing bore with a suitable pry bar. Remove the axle shaft bearing only if it being replaced; do not reinstall used bearings. Use removal tool C-4167 and slide hammer tool C-637, or their equivalents, to remove the bearing.

To install:

7. Thoroughly clean and dry the bearing bore in the differential housing.
8. Insert the new bearing into the pilot of bearing installation tool C-4198, or equivalent, and attach to the handle. Insert the bearing to the housing until it is seated against the bore shoulder.
9. Install the new seal using tool C-4203, or equivalent, with the flat side of the tool facing the seal. When the installation tool contacts the housing flange face, the seal is installed to the correct depth.
10. Lubricate the bearing bore and seal lip, insert the axle shaft into the housing and engage the splines. With the shaft in place, install the C-clip lock and push the shaft outward to seal the lock.
11. Install the mate shaft, align the hole in the shaft with the lock screw hole in the differential case and install the lock screw. Tighten the lock screw to 8 ft. lbs. (11 Nm).
12. Thoroughly clean and dry the case cover, mating surface, bolts and bolt holes. Apply silicone sealer to the cover and install.
13. Connect the CV driveshaft.
14. Level the vehicle and fill the differential with multi-purpose gear lubricant.
15. Road test the vehicle and check for leaks and correct front axle operation.

RIGHT SIDE AND INTERMEDIATE SHAFT

➧ See Figures 49, 50, 51 and 52

1. Raise the vehicle and support safely.
2. Remove the tire and wheel assembly.
3. Remove the cotter pin, nut lock and spring washer from the stub shaft. Remove the hub nut and washer.
4. Remove the bolts that attach the inner CV-joint to the axle shaft flange.
5. Separate the stub shaft splines from the hub bearing splines and remove the CV-joint shaft.
6. Remove the differential housing cover.
7. Disconnect the 4WD indicator lamp switch and the vacuum tube from the shift motor. Remove the shift motor, housing cover and gasket from the shift motor housing.
8. Remove the bearing seal/retainer attaching screws accessible via the holes in the axle shaft flange.
9. Remove the outer axle shaft from the differential housing.
10. Remove the snapring and the splined gear from the outer axle shaft. Separate the bearing and seal from the outer axle shaft.
11. Remove the shift collar from the shift motor housing.
12. Rotate the differential case so that the different pinion mate gear shaft lock screw is accessible. Remove the lock screw and the pinion mate gear shaft from the differential case.
13. Force the intermediate shaft toward the center of the vehicle and remove the shaft C-clip lock from the recessed groove in the axle shaft. Remove the intermediate shaft from the differential housing and tube.

To install:

14. Insert the axle shaft into the tube and housing and engage the splines. With the shaft in place, install the C-clip lock and push the shaft outward to seal the lock.
15. Install the mate shaft, align the hole in the shaft with the lock screw hole in the differential case and install the lock screw. Tighten the lock screw to 8 ft. lbs. (11 Nm).
16. Install the shift collar to the intermediate shaft.
17. Install a new seal to the seal retainer and install to the outer shaft. Press on the new bearing, install the splined gear and the snapring.
18. Insert the outer axle shaft into the shift motor housing. Tighten the attaching screws to 17 ft. lbs. (23 Nm).
19. The remainder of installation is the reverse of removal. Lubricate the contact surface area of the CV driveshaft wear sleeve with grease and install the CV driveshaft. Tighten the hub nut to 190 ft. lbs. (258 Nm). Install the spring washer, nut lock and a new cotter pin.
20. Level the vehicle and fill the differential with multi-purpose gear lubricant.
21. Road test the vehicle and check for leaks and correct front axle operation.

Model 60 Axle

1. Raise and support the front end on jackstands.
2. Remove the caliper from the knuckle and wire it out of the way.
3. Remove the locking hub.

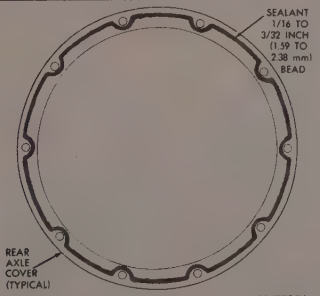


Fig. 48 Correct sealant application on the housing cover

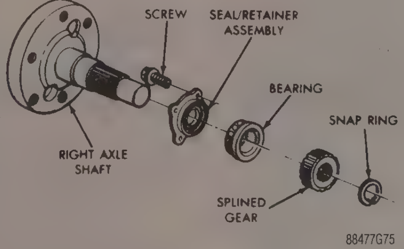


Fig. 49 Right axle shaft assembly on the disconnect axle

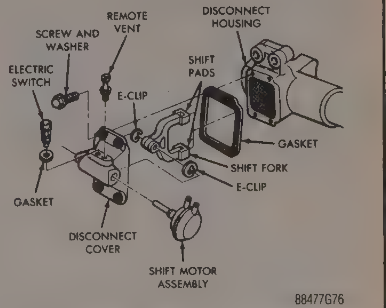


Fig. 50 Exploded view of the disconnect housing cover assembly

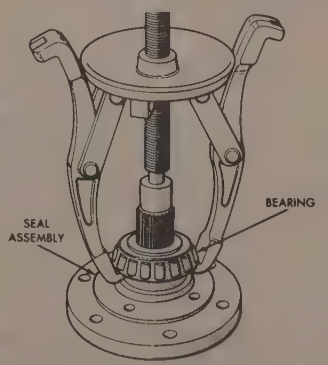


Fig. 51 Use a puller to remove the bearing and seal assembly from the axle shaft

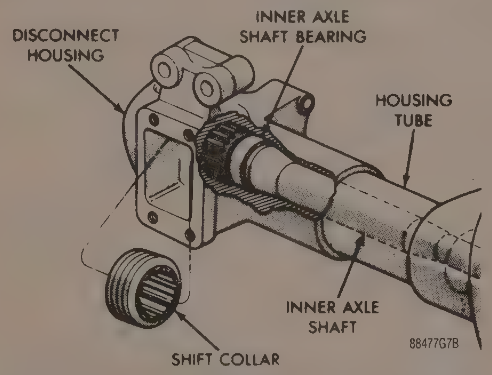


Fig. 52 Mounting position of the shift collar in relation to the inner axle shaft and bearing

4. Remove the front wheel bearing (see Section 1).
5. Remove the hub and rotor assembly.
6. Remove the spindle-to-knuckle bolts. Tap the spindle from the knuckle using a plastic mallet.
7. Remove the splash shield and a caliper support.
8. Pull the axle shaft out through the knuckle.
9. Using a slidehammer and bearing cup puller, remove the needle bearing from the spindle.
10. Clean the spindle bore thoroughly and make sure that it is free of nicks and burrs. If the bore is excessively pitted or scored, the spindle must be replaced.

To install:

11. Insert a new spindle bearing in its bore with the printing facing outward. Drive it into place with a driver. Install a new bearing seal with the lip facing away from the bearing.
12. Pack the bearing with waterproof wheel bearing grease.
13. Pack the thrust face of the seal in the spindle bore and the V-seal on the axle shaft with waterproof wheel bearing grease.
14. Carefully guide the axle shaft through the knuckle and into the housing. Align the splines and fully seat the shaft. Place the bronze spacer on the shaft. The chamfered side of the space must be inboard.
15. Install all remaining components in the reverse order of removal.

Pinion Seal

REMOVAL & INSTALLATION

Model 60 and 70 Axle

See Figures 53 and 54

➥A torque wrench capable of at least 300 ft. lbs. (408 Nm) is required for pinion seal installation.

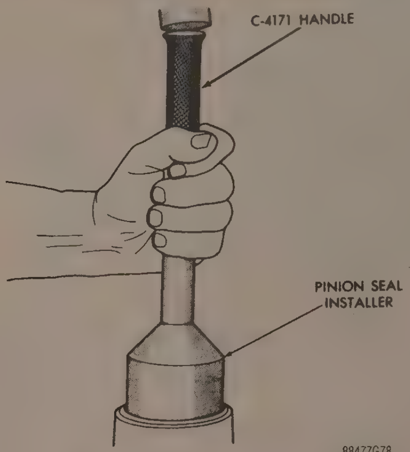


Fig. 53 Install the pinion seal using the special tool shown, or equivalent—Model 60/70 axle

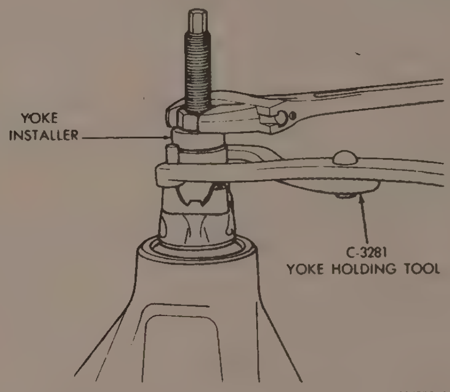


Fig. 54 Install the pinion and yoke using the special tools shown, or equivalent—Model 60/70 axle

1. Raise and support the truck on jackstands.
2. Allow the axle to hang freely.
3. Matchmark and disconnect the driveshaft from the front axle.
4. Using a holding tool, hold the pinion flange while removing the pinion nut.
5. Using a puller, remove the pinion flange.
6. Use a puller to remove the seal, or punch the seal out using a pin punch.

To install:

7. Thoroughly clean the seal bore and make sure that it is not damaged in any way. Coat the sealing edge of the new seal with a small amount of 80W/90 oil and drive the seal into the housing using a seal driver.
8. Coat the inside of the pinion flange with clean 80W/90 oil and install the flange onto the pinion shaft.
9. Install the nut on the pinion shaft and tighten it to 250–300 ft. lbs. (340–408 Nm).
10. Connect the driveshaft.

Model 44 Axle

➥A torque wrench capable of at least 225 ft. lbs. (305 Nm) is required for pinion seal installation.

1. Raise and safely support the vehicle with jackstands under the frame rails. Allow the axle to drop to rebound position for working clearance.
2. Mark the companion flange and U-joints for correct reinstallation position.
3. Remove the driveshaft. Use a suitable tool to hold the companion flange. Remove the pinion nut and companion flange.
4. Install a new pinion seal after lubricating the sealing surfaces. Use a suitable seal driver. Install the companion flange and pinion nut. Tighten the nut to 200–220 ft. lbs. (272–299 Nm).

REAR AXLE

Axle Shaft, Bearing and Seal

⁂ CAUTION

Before servicing any axle shafts, be sure to jack and support the truck so that both rear wheels are off the ground. This will ensure that the vehicle will not roll off the supports if the vehicle is equipped with a limited slip rear axle and one wheel is turned inadvertently.

REMOVAL & INSTALLATION

Chrysler Axles

➧ See Figures 55, 56, 57, 58 and 59

➡There is no provision for axle shaft end-play adjustment on these axles.

1. Jack up the vehicle and remove the rear wheels.
2. Clean all dirt from the housing cover and remove the housing cover to drain the lubricant.
3. Remove the brake drum.
4. Rotate the differential case until the differential pinion shaft lockscrew can be removed. Remove the lockscrew and pinion shaft.
5. Push the axle shafts toward the center of the vehicle and remove the C-locks from the grooves on the axle shafts.
6. Pull the axle shafts from the housing, being careful not to damage the bearing which remains in the housing.
7. Inspect the axle shaft bearings and replace any doubtful parts. Whenever the axle shaft is replaced, the bearings should also be replaced.
8. Remove the axle shaft seal from the bore in the housing using the button end of the axle shaft, or a suitable removal tool.

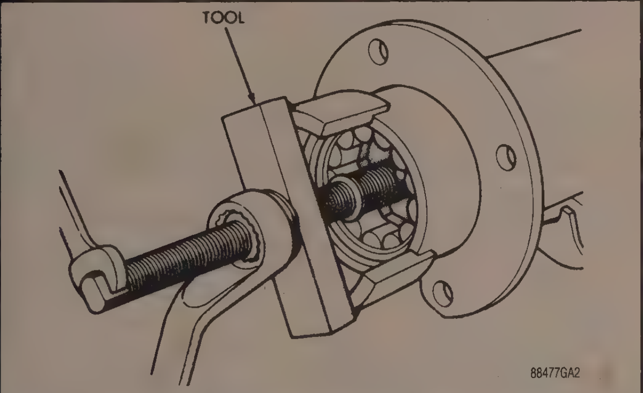


Fig. 55 Removing the axle shaft bearing and seal from the Chrysler axle

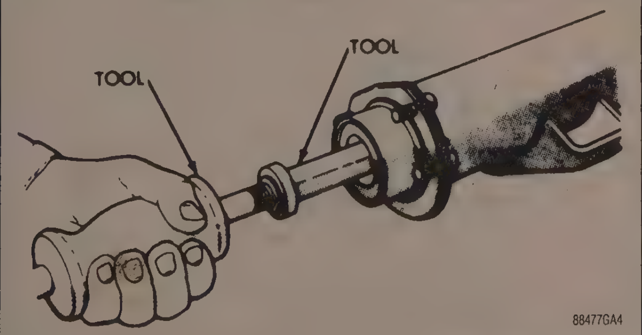


Fig. 56 Use a slide hammer to remove the axle shaft bearing and seal from the Chrysler axle

9. Remove the axle shaft bearing from the housing. On standard axles, use a slide hammer and adapter. On the 9¼ in. HD axle, use a puller such as C-4828, or its equivalent. Do not reuse the bearing or the seal.
10. Check the bearing shoulder in the axle housing for imperfections. These should be corrected with a file.
11. Clean the axle shaft bearing cavity.

To install:

12. Grease and install the axle shaft bearing in the cavity. An installer tool is recommended, although a drive can be used. Be sure that the bearing is not cocked and that it is seated firmly against the shoulder.
13. Install the axle shaft bearing seal. It should be seated beyond the end of the flange face.
14. Insert the axle shaft, making sure that the splines do not damage the seal. Be sure that the splines are properly engaged with the differential side gear splines.
15. Install the C-locks in the grooves on the axle shafts. Pull the shafts outward so that the C-locks seat in the counterbore of the differential side gears.
16. Install the differential pinion shaft through the case and pinions. Install the lockscrew and secure it in position.
17. Clean the housing and gasket surfaces. Install the cover and a new gasket. Refill the axle with the specified lubricant.

➡Replacement differential cover gaskets may not be available. The use of gel type non-sticking sealant is recommended.

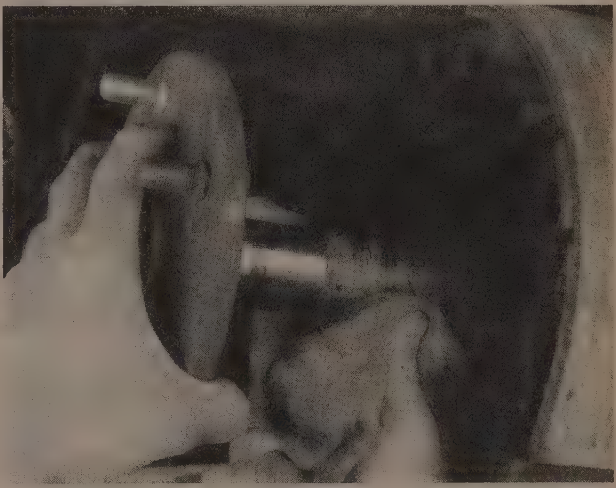


Fig. 57 Slide out the axle shaft from the housing

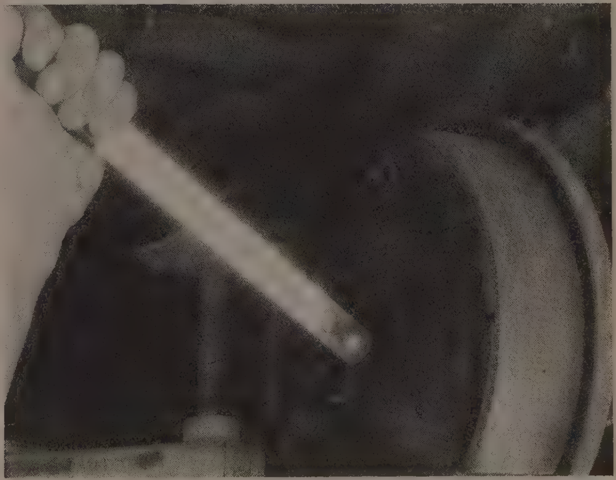


Fig. 58 Use a suitable tool to pry out and remove the axle shaft seal

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Fig. 59 Install the axle shaft seal using a suitable seal driver

Model 60 and 70

1. Remove the axle shaft flange locknuts and washers, or bolts.
2. On axles with locknuts, rap the axle shafts sharply in the center of the flange with a hammer to free the dowels.
3. Remove the tapered dowels and/or axle shafts.

To install:

4. Clean the gasket area with solvent and install a new flange gasket.
5. Install the axle shaft in to the housing.
6. If the axle has an outer wheel bearing seal, install new gaskets on each side of the seal mounting flange.
7. Install the tapered dowels, lockwashers, and nuts or Durlock® bolts. Tighten the 7⁄16—20 nuts to 40–70 ft. lbs. (54–95 Nm); the ½—20 nuts to 65–105 ft. lbs. (88–143 Nm); the Durlock® bolt to 60 ft. lbs. (82 Nm).

Full-Floating Axle Rear Wheel Bearings

REMOVAL & INSTALLATION

Model 60 and 70

The wheel bearings on the 200 and 300 series full floating rear axles are packed with wheel bearing grease. Axle lubricant can also flow into the wheel hubs and bearings, however, wheel bearing grease is the primary lubricant.

1. Set the parking brake and loosen the axle shaft bolts.
2. Raise the rear wheels off the floor and place jackstands under the rear axle housing so that the axle is parallel with the floor.
3. Remove the axle shaft bolts.
4. Remove the axle shaft and gaskets.
5. With the axle shaft removed, remove the gasket from the axle shaft flange studs.
6. Bend the lockwasher tab away from the locknut, and then remove the locknut, lockwasher, and the adjusting nut.
7. Remove the outer bearing cone and pull the wheel straight off the axle.
8. With a piece of hardwood or a brass drift which will just clear the outer bearing cup, drive the inner bearing cone and inner seal out of the wheel hub.
9. Wash all the old grease or axle lubricant out of the wheel hub, using a suitable solvent.
10. Wash the bearing cups and rollers, then inspect them for pitting, galling, and uneven wear patterns. Inspect the roller for end wear.
11. If the bearing cups are to be replaced, drive them out with a brass drift. Install the new cups with a block of wood and hammer or press them in.
12. If the bearing cups are properly seated, a 0.0015 in. (0.038mm) feeler gauge will not fit between the cup and the wheel hub. The gauge should not fit beneath the cup. Check several places to make sure the cups are squarely seated.
13. Pack each bearing cone and roller with a bearing packer or in the manner previously outlined for the front wheel bearings on 2WD trucks. Use a multipurpose wheel bearing grease.
14. Place the inner bearing cone and roller assembly in the wheel hub. Install a new inner seal in the hub with a seal installation tool.
15. Install the wheel and the adjusting nut.
16. While rotating the wheel, tighten the adjusting nut to 120–140 ft. lbs. (162–189 Nm).
17. Back off the nut ⅓ turn (120°). This will provide 0.001–0.008 in. (0.0254–0.2032mm) end-play.
18. Install the lockring onto the spindle keyway.
19. Install the axle shaft and new gasket.

ADJUSTMENT

Full-Floating Model 60 and 70 Axles

1. Raise and support the rear end on jackstands.
2. Remove the axle shaft.
3. Remove the lock ring and loosen the adjusting nut.
4. While rotating the wheel, tighten the adjusting nut to 120–140 ft. lbs. (162–189 Nm).
5. Back off the nut ⅓ turn (120°). This will provide 0.001–0.008 in. (0.0254–0.2032mm) end-play.
6. Install the lock ring onto the spindle keyway.
7. Install the axle shaft and new gasket.

Pinion Seal

REMOVAL & INSTALLATION

Chrysler 7¼ and 8¼ In. Axles

See Figures 60, 61, 62 and 63

1. Raise the vehicle and support safely.
2. Matchmark and remove the driveshaft.
3. Remove the rear wheel and brake drums to prevent any drag.
4. Using an inch lb. torque wrench, measure the pinion bearing preload. Read the torque while the handle of the wrench is moving through several complete revolutions.
5. Using the proper tools, hold the companion flange and remove the drive pinion nut and washer.
6. Remove the companion flange. Lower the rear of the vehicle to prevent fluid loss.
7. Using a seal remover tool, remove the seal from the carrier and clean the seal seat.

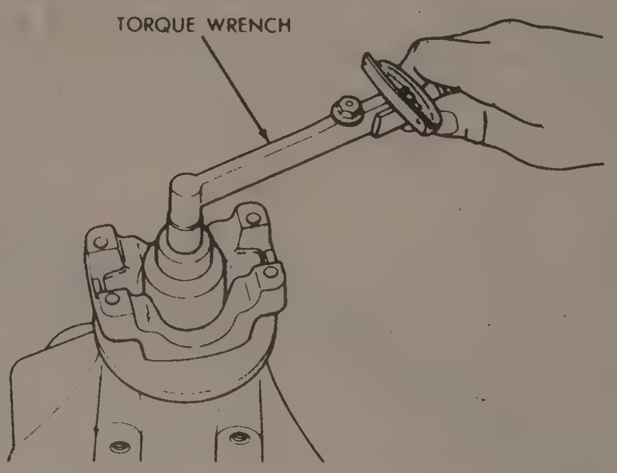

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Fig. 60 Check the pinion bearing preload as shown

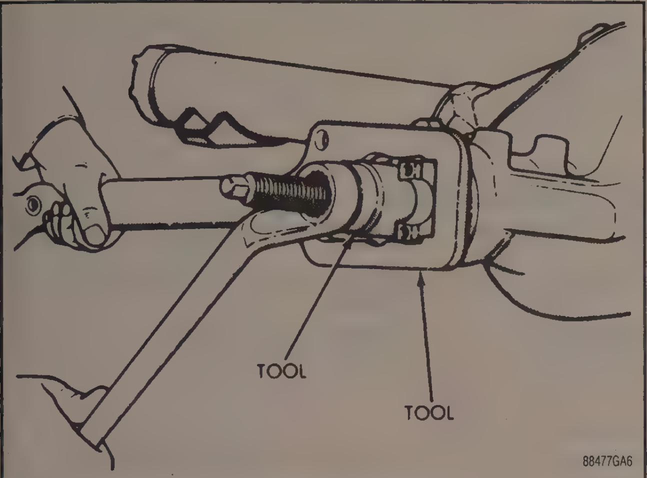

Fig. 61 Remove the drive pinion flange as shown

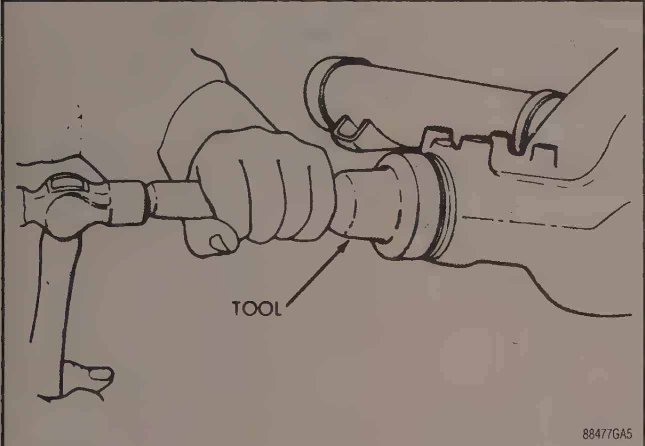

Fig. 62 Use a hammer and an installer tool to drive the pinion seal into place

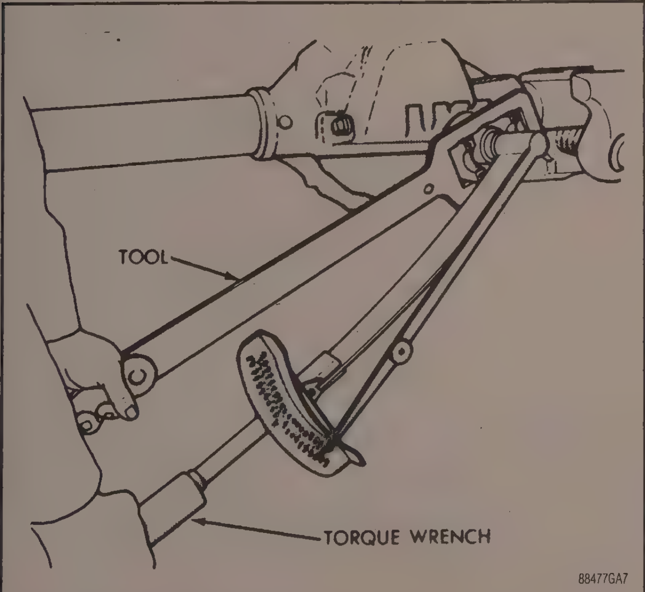

Fig. 63 Tighten the drive pinion nut as shown

To install:

8. The outside diameter of the seal is pre-coated with a special sealer so no sealing compound is required for installing. The seal is properly installed when the flange contacts the housing flange face.
9. Install the companion flange and the washer with the convex side out.
10. Tighten the pinion nut to 210 ft. lbs. (285 Nm) and check the pinion bearing preload. If the preload is less than the original preload measured, continue tightening the nut in very small increments until the proper preload is reached.
11. Install the driveshaft, drums and rear wheels.
12. Refill the differential with the proper lubricant and road test the vehicle and check for leaks.

Chrysler 8⅜ In. and 9¼ In. Axles

➡An inch pound torque wrench and a torque wrench capable of at least 250 ft. lbs. (340 Nm) are required for pinion seal installation.

1. Raise and safely support the vehicle with jackstands under the frame rails. Allow the axle to drop to rebound position for working clearance.
2. Remove the rear wheels and brake drums. No drag must be present on the axle.
3. Mark the companion flanges and U-joints for correct reinstallation position.
4. Remove the driveshaft.
5. Using an inch pound torque wrench and socket on the pinion yoke nut, measure the amount of torque needed to maintain differential rotation through several clockwise revolutions. Record the measurement.
6. Use a suitable tool to hold the companion flange. Remove the pinion nut and washer.
7. Place a drain pan under the differential, clean the area around the seal, and mark the yoke-to-pinion relations.
8. Use a 2-jawed puller to remove the pinion.
9. Remove the seal with a small prybar.
10. Thoroughly clean the oil seal bore.

➡If you are not absolutely certain of the proper seal installation depth, the proper seal driver must be used. If the seal is misaligned or damaged during installation, it must be removed and a new seal installed.

11. Drive the new seal into place with a seal driver. Coat the seal lip with clean, waterproof wheel bearing grease.
12. Coat the splines with a small amount of wheel bearing grease and install the yoke, aligning the matchmarks. Never hammer the yoke onto the pinion!
13. Install a NEW nut on the pinion.
14. Retain the yoke with a holding tool. Tighten the pinion nut to 210 ft. lbs. (285 Nm). Using the inch pound torque wrench, take several readings. Continue tightening the nut until the original recorded preload reading is achieved.

➡Under no circumstances should the preload be more than 5 inch lbs. (0.6 Nm) higher than the original reading.

15. Bearing preload should be uniform through several complete revolutions. If binding exists, the condition must be diagnosed and corrected. The assembly is unacceptable if the final pinion nut torque is below 210 ft. lbs. (285 Nm) or pinion bearing preload is not correct.

✲✲ WARNING

Under no circumstances should the nut be backed off to reduced the preload reading! If the preload is exceeded, the yoke and bearing must be removed and a new collapsible spacer must be installed. The entire process of preload adjustment must be repeated.

16. Install the driveshaft using the matchmarks. Tighten the nuts to 15 ft. lbs. (20 Nm).

Model 60 and 70 Axles

➡A torque wrench capable of at least 300 ft. lbs. (408 Nm) is required for pinion seal installation.

1. Raise and support the truck on jackstands.
2. Allow the axle to hang freely.
3. Matchmark and disconnect the driveshaft from the front axle.
4. Using a holding tool, holding the pinion flange while removing the pinion nut.

5. Using a puller, remove the pinion flange.
6. Use a puller to remove the seal, or punch the seal out using a pin punch.
7. Thoroughly clean the seal bore and make sure that it is not damaged in any way. Coat the sealing edge of the new seal with a small amount of 80W/90 oil and drive the seal into the housing using a seal driver.
8. Coat the inside of the pinion flange with clean 80W/90 oil and install the flange onto the pinion shaft.
9. Install the nut on the pinion shaft and tighten it to 250–300 ft. lbs. (340–408 Nm).
10. Connect the driveshaft.

BASIC DRIVESHAFT PROBLEMS

Problem	Cause	Solution
Shudder as car accelerates from stop or low speed	• Loose U-joint • Defective center bearing	• Replace U-joint • Replace center bearing
Loud clunk in driveshaft when shifting gears	• Worn U-joints	• Replace U-joints
Roughness or vibration at any speed	• Out-of-balance, bent or dented driveshaft • Worn U-joints • U-joint clamp bolts loose	• Balance or replace driveshaft • Replace U-joints • Tighten U-joint clamp bolts
Squeaking noise at low speeds	• Lack of U-joint lubrication	• Lubricate U-joint; if problem persists, replace U-joint
Knock or clicking noise	• U-joint or driveshaft hitting frame tunnel • Worn CV joint	• Correct overloaded condition • Replace CV joint

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8

SUSPENSION AND STEERING

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WHEELS

Wheels

REMOVAL & INSTALLATION

➧ See Figures 1 and 2

The wheel attaching nuts must be tightened properly to ensure efficient brake operation. Overtightening the nuts or tightening them in the wrong sequence can cause distortion of the brake rotor and drums. Air wrenches are not recommended for tightening wheel nuts. Always use a torque wrench. The correct tightening sequence is a diagonal crisscross pattern.

1. Apply the parking brake and block the opposite wheel.
2. If equipped with an automatic transmission, place the selector lever in P. For manual transmission models, place the shifter in Reverse.
3. If equipped, remove the wheel cover or hub cap.
4. Break loose the lug nuts. If a nut is stuck, never use heat to loosen it or damage to the wheel and bearings may occur. If the nuts are seized, one or two heavy hammer blows directly on the end of the bolt head usually loosens the rust. Be careful as continued pounding will likely damage the brake drum or rotor.
5. Raise the vehicle until the tire is clear of the ground. Support the vehicle safely using jackstands.
6. Remove the lug nuts and the tire and wheel assembly.

To install:

7. Make sure the wheel and hub mating surfaces as well as the wheel lug studs are clean and free of all foreign material. Always remove rust from the wheel mounting surfaces and the brake rotors/drums. Failure to do so may cause the lug nuts to loosen in service.
8. Position the wheel on the hub or drum and hand-tighten the lug nuts. Tighten all the lug nuts, in a crisscross pattern, until they are snug.
9. Remove the supports and lower the vehicle. Tighten the lug nuts, in a crisscross pattern (refer to the illustrations provided). Always use a torque wrench to achieve the proper lug nut torque and to prevent stretching the wheel studs.
10. Repeat the torque pattern to assure proper wheel tightening.
11. If equipped, install the hub cap or wheel cover.

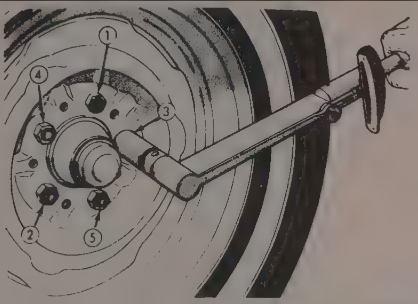

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Fig. 1 Use a torque wrench to tighten 5 bolt wheels in the order shown

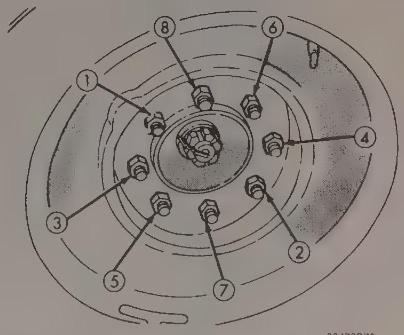

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Fig. 2 Tighten 8 bolt lug patterns as shown

INSPECTION

Inspect the wheels on a frequent basis. Replace any wheel that is found to be cracked, bent, severely dented, has excessive runout (warpage) or has broken welds. Inspect the tire inflation valve frequently for wear, leakage, cuts or looseness. Replace any valve whose condition is suspect.

Wheel Lug Studs

REPLACEMENT

Front

➧ See Figure 3

1. Elevate and safely support the vehicle.
2. Remove the wheel.
3. Disconnect the brake line from the front caliper, and plug the line immediately.
4. Remove the brake caliper.

✻✻ CAUTION

Brake pads and shoes may contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

5. Remove the axle hub with the brake disc attached.
6. Use a copper mallet to drive out the wheel studs.

To install:

7. Fit the new lug into the hole. Drive it in with the copper mallet until fully seated.
8. Install the disc and hub. Install the brake caliper and attach the brake line to the caliper.
9. Bleed the brake system. Install the wheel and lower the vehicle to the ground then tighten the lug nuts.

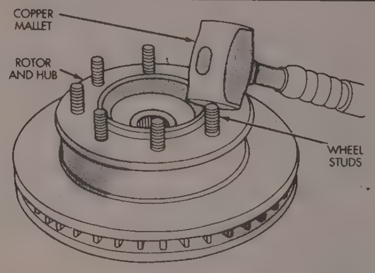
Rear

1. Elevate and safely support the vehicle.
2. Remove the wheel.
3. Remove the brake drum.

✻✻ CAUTION

Brake pads and shoes may contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air. Avoid inhaling any dust from brake surfaces. When cleaning brakes, use commercially available brake cleaning fluids.

4. Use a copper mallet to drive out the wheel lug studs.
5. Fit the new lug stud into the hole. Install a couple of thick washers over the stud, then the lug nut. Tighten the lug nut until the stud is fully drawn onto the hub.
6. Install the brake drum and wheel then lower the vehicle to the ground.



88478G68

Fig. 3 Use a copper mallet to separate the wheel lug studs from the hub/rotor assembly

FRONT SUSPENSION

Coil Springs

REMOVAL & INSTALLATION

Except Dakota

1989–93 MODELS

➧ See Figure 4

1. Raise and support the front end on jackstands placed under the frame.
2. Remove the wheels.
3. Remove the brake calipers and suspend them out of the way. DO NOT DISCONNECT THE BRAKE LINE! Remove the inner pad. See Section 9.
4. Remove the shock absorbers.
5. Disconnect the sway bar.
6. Remove the lower control arm strut.
7. Install a spring compressor, such as tool DD-1278, tighten the nut finger-tight and back it off ½ turn.
8. Remove the ball joint nuts.
9. Using ball joint separator C-3564-A, or equivalent, spread the tool against the lower joint just enough to exert pressure then strike the knuckle sharply with a hammer to free the joint. NEVER ATTEMPT TO FORCE THE BALL JOINT OUT WITH TOOL PRESSURE ALONE! Remove the tool.
10. Slowly loosen the spring compressor until all tension is relieved from the coil.
11. Remove the compressor and spring.

To install:

12. Position the spring on the control arm and install the compressor.
13. Compress the spring until the ball joint is properly positioned.
14. Install the ball joint nuts and tighten them to 135 ft. lbs. (183 Nm).
15. Install the strut. Tighten the mounting bolts to 95 ft. lbs. (129 Nm); the retainer nut to 50 ft. lbs. (68 Nm).
16. The remainder of installation is the reverse of removal. Tighten the following components to specifications.
    - Sway bar link—100 inch lbs. (11 Nm)
    - Upper shock end—25 ft. lbs. (34 Nm)
    - Lower shock end—15 ft. lbs. (20 Nm)

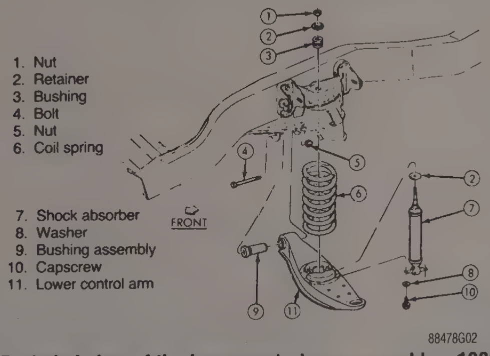


Fig. 4 Exploded view of the lower control arm assembly—1989–93 Pick-up and Ramcharger

1994–96 MODELS

➧ See Figure 5

1. Raise and safely support the vehicle on jackstands.
2. Remove the wheel.
3. Remove the brake caliper and rotor.
4. Disconnect the tie rod from the steering knuckle.
5. Disconnect the stabilizer bar link from the lower arm.
6. Support the lower arm outboard end with a floor jack. Place the jack under the arm in front of the shock mount.

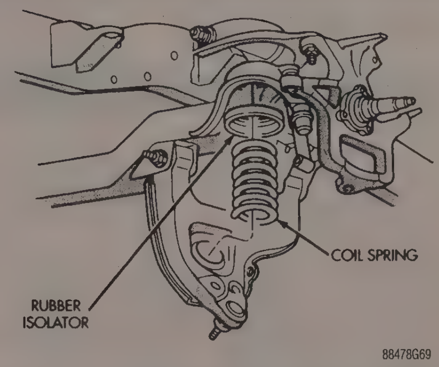


Fig. 5 View of the coil spring mounting—1994–96 models

7. Remove the cotter pin and nut from the lower ball stud. Use remover tool C–4150A, or equivalent, to separate the ball stud.
8. Remove the lower shock bolt from the suspension arm.
9. Lower the jack and suspension arm until spring tension is relieved. Remove the spring and rubber isolator.
10. Installation is the reverse of removal. Install the rubber isolator on top of the spring. Position the spring into the upper spring seat and lower suspension arm.
11. Raise the suspension arm with the jack and position the shock into the suspension arm mount. Install the shock bolt and tighten to specification.

Dakota

➧ See Figure 6

➡For 4WD models, refer to the torsion bar procedure.

1. Raise the vehicle and support safely.
2. Remove the shock absorber.
3. Disconnect the sway bar from the lower control arm, if equipped.
4. Install spring compressor tool DD–1278, or equivalent to the coil spring. Tighten the nut finger-tight, then back off half a turn.
5. Remove the cotter pin and lower ball joint nut.
6. Release the lower ball joint taper using ball stud loosening tool C–3564–A, or equivalent.
7. Remove the tool and remove the ball stud from the control arm. Release the compressor tool from the coil spring.
8. Pull the arm down and remove the spring with the rubber isolation pad from the vehicle.

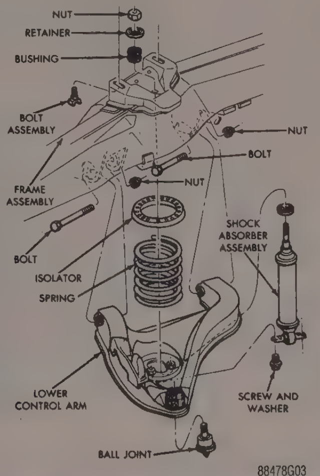


Fig. 6 Exploded view of the lower control arm and spring assembly—Dakota models

9. Installation is the reverse of removal. Install the spring with the rubber isolator. Install the compressor tool and compress it enough so the lower ball joint can be inserted through the knuckle.

10. Tighten the lower ball joint nut to 135 ft. lbs. (183 Nm). Install a new cotter pin. Remove the spring compressor.

Leaf Springs

REMOVAL & INSTALLATION

➧ See Figures 7, 8, 9 and 10

1. Raise and support the front end on jackstands placed under the frame. The wheels should still be on the ground, but the weight should be off of the springs.
2. Remove the nuts, lockwashers and U-bolts securing the spring to the axle.
3. Remove the spring shackle bolts, shackles and front eye bolt.
4. Remove the spring.

To install:

5. Position the spring in place and install the eye bolt and nut. Do not tighten the bolt yet.
6. Install the shackles and bolts. Tighten them just enough to make them snug.
7. Make sure that the spring center bolt enters the locating hole in the axle pad.
8. Install the U-bolts, lockwashers and nuts. Make them just snug for now.
9. Lower the truck to its normal position with the weight back on the springs. Now tighten all bolts and nuts as follows:

- U-bolt nuts: 95 ft. lbs. (129 Nm)
- Shackle bolts: 80 ft. lbs. (108 Nm)
- Eye bolt: 80 ft. lbs. (108 Nm)

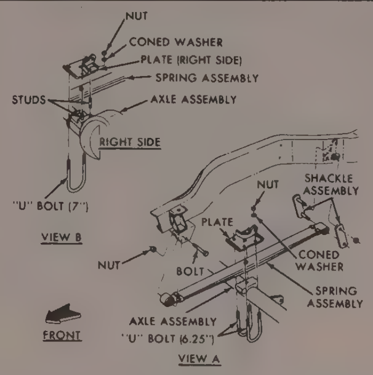


Fig. 7 Exploded view of the front leaf spring suspension—4WD Pick-up and Ramcharger with model 44 front axle

Torsion Bar

REMOVAL & INSTALLATION

➧ See Figure 11

➡Torsion bars are used on 4WD Dakotas only.

➡The left and right side torsion bars are not interchangeable. The bars are identified by the letter R or L stamped into one end of the bar. The bars do not have a specific front or rear end and can be installed with either end facing forward.

1. Remove the upper control arm jounce bumper.
2. Raise the vehicle with the front suspension hanging free and support it safely with jackstands.
3. Release the load from the torsion bar by turning the adjustment bolt counterclockwise.
4. Remove the adjustment bolt from the swivel and then remove the torsion bar and the anchor together from the vehicle. Remove the torsion bar from the anchor.
5. Remove any dirt, rust or pebbles from the hex shaped socket in the anchor and lower control arm.
6. Inspect the anchor and bolt and replace them if any damage or corrosion exists.

To install:

7. Insert the torsion bar ends into the sockets.
8. Position the anchor and the bushing in the crossmember. Insert the adjustment bolt and thread it into the swivel.
9. Turn the adjustment bolt clockwise to apply a load on the bar.
10. Lower the vehicle.
11. Set the front suspension height. The difference between the distance from the surface that the tires are on to the lower control arm inner pivot and the distance that the tires are on to the outer end of the arm is 1–1½ in. (25–38mm).
12. Install the upper control arm jounce bumper.

Shock Absorbers

REMOVAL & INSTALLATION

Coil Spring Suspension

➧ See Figures 12, 13, 14, 15 and 16

1. Raise and support the vehicle with jackstands positioned at the extreme front ends of the frame rails.
2. Remove the wheel.
3. Remove the upper mounting bolt.
4. Remove the two lower mounting bolts.
5. Remove the shock absorber.
6. When installing the shock absorber, make sure the upper bushings are in the correct position. Replace any worn or cracked bushings. Tighten the top nut to 25 ft. lbs. (34 Nm). Then, tighten the lower bolts to 15 ft. lbs. (20 Nm).

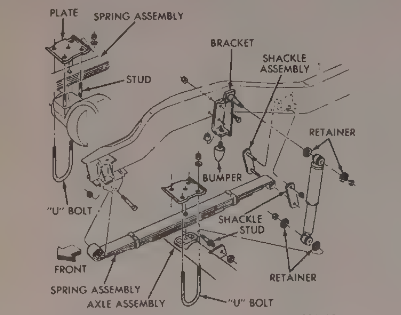


Fig. 8 Exploded view of the front leaf spring suspension—4WD Pick-up and Ramcharger with model 60 front axle

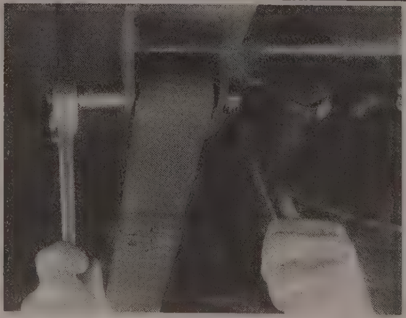


Fig. 9 Use a back-up wrench when loosening the spring shackle bolt for the front leaf springs

Fig. 10 Unbolt the rear spring mount, then carefully remove the spring from the vehicle

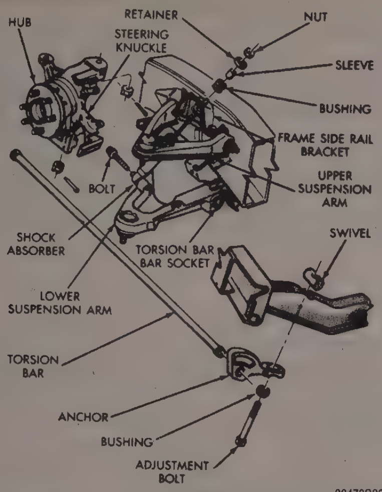
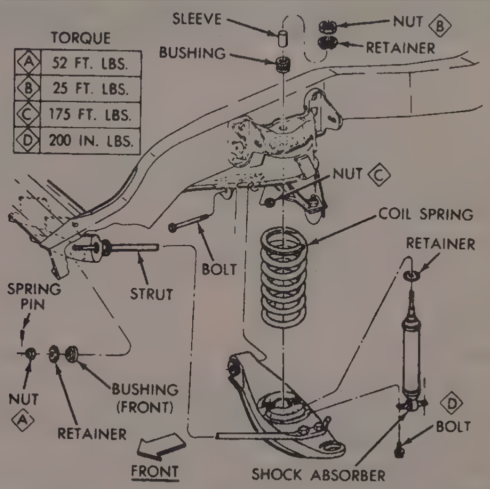

HUB
RETAINER
NUT
STEERING KNUCKLE
SLEEVE
BUSHING
FRAME SIDE RAIL BRACKET
UPPER SUSPENSION ARM
BOLT
SHOCK ABSORBER
SWIVEL
TORSION BAR BAR SOCKET
LOWER SUSPENSION ARM
TORSION BAR
ANCHOR
BUSHING
ADJUSTMENT BOLT
88478G06

Fig. 11 Exploded view of the front torsion bar assembly—4WD Dakota


SLEEVE
NUT B
BUSHING
RETAINER
NUT C
COIL SPRING
RETAINER
BOLT
STRUT
SPRING PIN
NUT A
BUSHING (FRONT)
RETAINER
D
BOLT
FRONT
SHOCK ABSORBER
88478G07

TORQUE	
A	52 FT. LBS.
B	25 FT. LBS.
C	175 FT. LBS.
D	200 IN. LBS.

Fig. 12 Exploded view of the front shock absorber mounting—Ram Pick-up and Ramcharger

Fig. 13 First unbolt the upper shock mount . . .

Fig. 14 . . . next detach the lower portion of the shock absorber from its mounting location

Fig. 15 Remove all hardware from the mount(s), organize the various pieces and set them in a safe location

Fig. 16 Carefully maneuver the shock absorber from its mounts and remove from the vehicle

Leaf Spring Suspension

1. Raise and safely support the vehicle on jackstands.
2. Remove the wheel.
3. Remove the two upper shock absorber bracket-to-frame bolts.
4. Remove the lower bracket nut and remove the shock absorber.
5. If new shocks are being installed, remove the upper bracket from the old shock. Replace any worn or cracked bushings.
6. When installing the shock absorbers, tighten all fasteners to 50 ft. lbs. (68 Nm). Installation of the remaining components is the reverse of the removal.

Torsion Bar Suspension

1. Remove the hardware from the shock absorber stud.
2. Raise and safely support the vehicle on jackstands.
3. Remove the wheel.
4. Remove the lower bolts, then remove the shock absorber.

To install:

5. Install the lower retainer and grommet on the shock absorber stud. Insert the shock absorber through the frame hole. Install the lower bolt and tighten to 100 ft. lbs. (136 Nm.)
6. Install the upper grommet and retainer on the shock absorber stud. Install the bayonet nut and tighten to 30 ft. lbs. (41 Nm).

Upper Ball Joint

INSPECTION

To inspect the ball joints, unload the suspension and support the vehicle safely. Upper ball joints on 2WD vehicles and any ball joint on 4WD vehicles should be replaced if any play exists at all.

REMOVAL & INSTALLATION

Except Dakota

2WD MODELS

1. Raise and safely support the vehicle on jackstands.
2. Position a support at the outer end of the lower control arm and lower the vehicle so that the support compresses the coil spring.
3. Remove the tire and wheel assembly.
4. Remove the cotter pin and the stud nut.
5. Release the upper ball joint taper using ball stud loosening tool C–3564–A, or equivalent.
6. Unthread the ball joint from the control arm with tool C–3561, or equivalent.
7. The installation is the reversal of the removal procedure. Tighten the ball joint itself to 125 ft. lbs. (169 Nm). Tighten the upper ball stud nut to 135 ft. lbs (183 Nm).

4WD MODELS

1. Raise and safely support the vehicle on jackstands.
2. Remove the front axle shaft.
3. Disconnect the tie rod end from the steering knuckle. On the left side, disconnect the drag link ball stud from the steering knuckle.
4. On the left side, remove the nuts and washers from the steering knuckle arm and remove the arm and spring, if equipped, from the knuckle.
5. If equipped with a Model 44 front axle, remove the ball joint nuts and discard the lower nut. Use a brass drift and hammer to separate the steering knuckle from the axle tube yoke. Use tool C–4169 to remove the sleeve from the upper yoke arm.
6. Remove the snapring from the ball joint. Install the knuckle in a vise and use tools D–150–1, D–150–3 and C–4212–L to remove the ball joint from the knuckle.
7. If equipped with a Model 60 front axle, remove the bolts from the knuckle lower cap. Dislodge the cap from the steering knuckle and axle tube yoke. Remove the steering knuckle. Use tool D–192 to remove the upper socket pin from the axle tube upper arm bore. Remove the seal.

To install:

8. If equipped with a Model 44 front axle, use tools C–4212–L and C–4288 to force the upper ball joint into the steering knuckle. Install the snapring and install a new rubber boot. Thread the replacement sleeve into the upper yoke bore so that 2 threads are exposed at the top of the yoke. Position the knuckle on the axle tube yoke and install a new lower ball stud nut, then tighten to 80 ft. lbs. (108 Nm). Using the special socket, tighten the sleeve to 40 ft. lbs. (54 Nm). Install the upper ball stud nut and torque to 100 ft. lbs. (136 Nm) and install a new cotter pin.
9. If equipped with a Model 60 front axle, use tool D–192 to install the upper socket pin to the axle tube upper arm bore. Install a new seal. Tighten to 500–600 ft. lbs. (668–813 Nm). Position the knuckle over the socket pin. Fill the lower socket cavity with grease. Install the lower cap and tighten the bolts to 80 ft. lbs. (108 Nm).
10. On the left side, install the spring, if equipped and the steering knuckle arm to the steering knuckle.
11. Connect the tie rod to the end of the steering knuckle. On the left side, connect the drag link ball stud to the steering knuckle.
12. Install the front axle shaft and all related components.

Dakota

2WD MODELS

1. Raise and safely support the vehicle on jackstands.
2. Position a support at the outer end of the lower control arm and lower the vehicle so that the support compresses the coil spring.
3. Remove the tire and wheel assembly.
4. Remove the cotter pin and stud nut.
5. Release the upper ball joint taper using ball stud loosening tool C–3564–A, or equivalent.
6. Unthread the ball joint from the control arm with tool C–3561, or equivalent.
7. Installation is the reverse of removal.
   a. Tighten the ball joint itself to 125 ft. lbs. (169 Nm).
   b. Tighten the upper ball stud nut to 135 ft. lbs (183 Nm) and install a new cotter pin.

4WD MODELS

1. Raise and safely support the vehicle on jackstands.
2. Remove the CV driveshaft from the vehicle.
3. Turn the torsion bar adjustment nut counterclockwise to relieve all tension from the torsion bar.
4. Remove the cotter pin from the upper ball stud.
5. Release the upper ball joint taper using ball stud loosening tool C–3564–A, or equivalent. Remove the tool.
6. Remove the upper ball stud seal.
7. Force the ball joint from the arm using the ball stud removal and installation tool C–4212.

To install:

8. Install the new ball joint using the ball stud removal and installation tool C–4212.
9. Install the ball stud seal.
10. Insert the upper ball stud in the steering knuckle arm bore and install the nut. Tighten the nut to 105 ft. lbs. (142 Nm) and install a new cotter pin.
11. Turn the torsion bar adjustment nut clockwise to apply a load on the bar.
12. Install the CV driveshaft and all related parts.
13. Lower the vehicle.
14. Set the front suspension height. The difference between the distance from the surface that the tires are on to the lower control arm inner pivot and the distance that the tires are on to the outer end of the arm is 1–1½ in. (25–38mm).

Lower Ball Joint

INSPECTION

To inspect the lower ball joints, unload the suspension. Lower ball joints on 2WD vehicles should be replaced if the have more than 0.020 in. (0.5mm) play. Any ball joint on 4WD vehicles should be replaced if any play exists.

REMOVAL & INSTALLATION

Except Dakota

2WD MODELS

➧ See Figures 17, 18 and 19

1. Raise and safely support the vehicle on jackstands.
2. Remove the shock absorber.
3. Remove the strut bar and disconnect the sway bar from the lower control arm, if equipped.
4. Install spring compressor tool DD–1278, or equivalent to the coil spring and tighten the nut finger-tight, then back off half a turn.
5. Remove the cotter pin and lower ball joint nut.
6. Release the lower ball joint taper using ball stud loosening tool C–3564–A, or equivalent.
7. Remove the tool and remove the ball stud from the control arm. Release the compressor tool from the coil spring.
8. Pull the arm down and remove the spring with the rubber isolation pad from the vehicle. Remove the ball joint boot. Use tool C–4212, or an appropriate ball joint press to remove the ball joint from the arm.

To install:

9. Use the remover tool to press the ball joint into the arm. Install a new rubber boot. Install the spring with the rubber isolators. Install the compressor tool and compress it enough so the lower ball joint can be inserted through the knuckle.

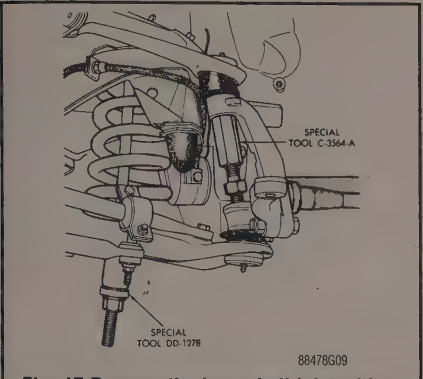


Fig. 17 Remove the lower ball joint with a breaker tool like the one shown

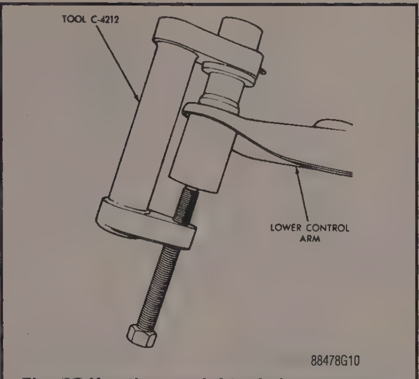


Fig. 18 Use the special tool shown, or equivalent to remove the lower ball joint

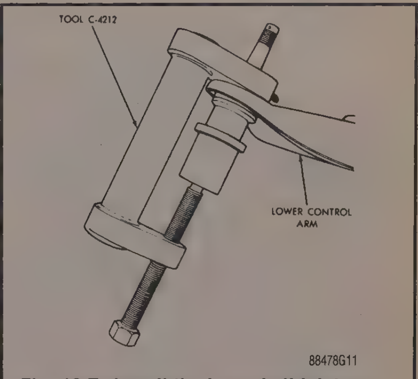


Fig. 19 To install the lower ball joint, use the special tool to press it into place

10. Tighten 11/16 lower ball joint nuts to 135 ft. lbs. (183 Nm). Tighten ¾ nuts to 175 ft. lbs. (237 Nm). Install a new cotter pin. Remove the spring compressor.
11. Install the strut bar and connect the sway bar from the lower control arm, if equipped.
12. Install the shock absorber.

4WD MODELS

1. Raise and safely support the vehicle on jackstands.
2. Remove the front axle shaft.
3. Disconnect the tie rod end from the steering knuckle. On the left side, disconnect the drag link ball stud from the steering knuckle.
4. On the left side, remove the nuts and washers from the steering knuckle arm and remove the arm and spring, if equipped, from the knuckle.
5. If equipped with a Model 44 front axle, remove the ball joint nuts and discard the lower nut. Use a brass drift and hammer to separate the steering knuckle from the axle tube yoke.
6. Remove the snapring from the ball joint. Install the knuckle in a vise and use tools D–150–1, D–150–3 and C–4212–L to remove the ball joint from the knuckle.
7. If equipped with a Dana 60 front axle, use tools C–4212–L, C–4366–1 and C–4366–2 to remove the lower ball joint.

To install:

8. If equipped with a Model 44 front axle, use tools C–4212–L and C–4288 to force the lower ball joint into the steering knuckle. Install the snapring and install a new rubber boot. Position the knuckle on the axle tube yoke and install a new lower ball stud nut. Tighten to 80 ft. lbs. (108 Nm). Install the upper ball stud nut and tighten to 100 ft. lbs. (136 Nm), then install a new cotter pin.
9. If equipped with a Model 60 front axle, use tools C–4212–L, C–4366–3 and C–4366–4 to install the seal and lower bearing cup into the axle tube yoke lower bore. Reposition the tools and install the lower bearing and seal into the bore. Position the knuckle over the socket pin. Fill the lower socket cavity with grease. Install the lower cap and tighten the bolts to 80 ft. lbs. (108 Nm).
10. On the left side, install the spring, if equipped and the steering knuckle arm to the steering knuckle.
11. Connect the tie rod to the end of the steering knuckle. On the left side, connect the drag link ball stud to the steering knuckle.
12. Install the front axle shaft and all related components.

Dakota

2WD MODELS

1. Raise and safely support the vehicle on jackstands.
2. Remove the shock absorber.
3. Disconnect the sway bar from the lower control arm, if equipped.
4. Install spring compressor tool DD–1278, or equivalent to the coil spring and tighten the nut finger-tight, then back off half a turn.
5. Remove the cotter pin and lower ball joint nut.
6. Release the lower ball joint taper using ball stud loosening tool C–3564–A, or equivalent.
7. Remove the tool and remove the ball stud from the control arm. Release the compressor tool from the coil spring.
8. Pull the arm down and remove the spring with the rubber isolation pad from the vehicle. Remove the ball joint boot. Use tool C–4212, or an appropriate ball joint press to remove the ball joint from the arm.

To install:

9. Use the remover tool to press the ball joint into the arm. Install a new rubber boot. Install the spring with the rubber isolators. Install the compressor tool and compress it enough so the lower ball joint can be inserted through the knuckle. Tighten the lower ball joint nut to 135 ft. lbs. (183 Nm). Install a new cotter pin. Remove the spring compressor.
10. Connect the sway bar to the lower control arm, if equipped.
11. Install the shock absorber.

4WD MODELS

1. Raise and safely suoport the vehicle on jackstands.
2. Remove the CV driveshaft.
3. Remove the torsion bar.
4. Remove the shock absorber lower attaching bolt.
5. Disconnect the stabilizer bar from the lower control arm.
6. Remove the cotter pin and the nut from the lower ball stud. Separate the lower ball stud from the steering knuckle.
7. Pry the peened ball joint retainer sections upward from the lower control arm and remove the ball joint from the arm.

To install:

8. Install the new ball joint in the control arm. Peen the ball joint housing retainer over to secure the ball joint. Install the grease seal.
9. Insert the ball stud into the steering knuckle bore. Install the nut and tighten to 120 ft. lbs. (163 Nm). Be sure to install ONLY a new cotter pin. The remainder of installation is the reverse of removal. Tighten each component to specifications.
10. Set the front suspension height so that the difference between the distance from the surface that the tires are on to the lower control arm inner pivot and the distance that the tires are on to the outer end of the arm is 1–1½ in. (25–38mm).
11. Have the alignment checked at a reputable repair facility.

Sway Bar

REMOVAL & INSTALLATION

➧ See Figures 20, 21 and 22

1. Disconnect the bar at each end link.
2. Remove the bolts from the frame mounting brackets.
3. Remove the sway bar.
4. Installation is the reverse of removal. Tighten the frame bracket bolts to 23 ft. lbs. (31 Nm).; the end links to 100 inch lbs. (11 Nm).

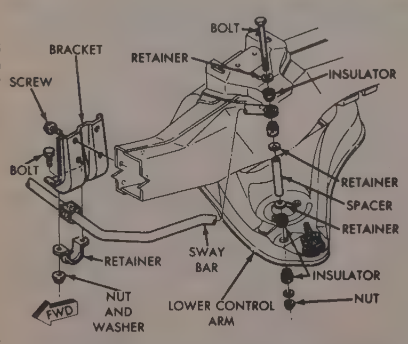
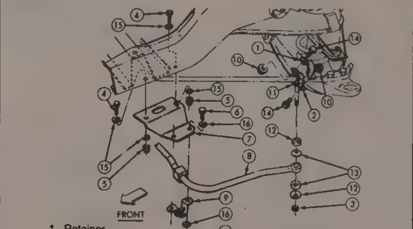

BOLT
BRACKET
RETAINER
SCREW
INSULATOR
BOLT
RETAINER
SPACER
RETAINER
RETAINER
SWAY BAR
INSULATOR
NUT
FWD
NUT AND WASHER
LOWER CONTROL ARM
88478G13

Fig. 20 Exploded view of the sway bar and related components—2WD Dakota models


FRONT
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

1. Retainer
2. Link assembly
3. Nut
4. Bolt
5. Lock nut
6. Bolt
7. Bracket
8. Shaft assembly
9. Retainer
10. Nut
11. Insulator
12. Retainer
13. Insulator
14. Bolt
15. Coned washer
16. Coned washer
17. Lock nut

88478G14

Fig. 21 Exploded view of the sway bar and related components—Ram Pick-up and Ramcharger models

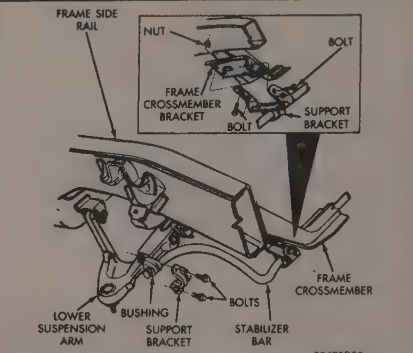

FRAME SIDE RAIL
NUT
BOLT
FRAME CROSSMEMBER BRACKET
BOLT
SUPPORT BRACKET
FRAME CROSSMEMBER
BOLTS
LOWER SUSPENSION ARM
BUSHING
SUPPORT BRACKET
STABILIZER BAR
88478G20

Fig. 22 Details of the stabilizer bar mounting—4WD Dakota models

Upper Control Arm

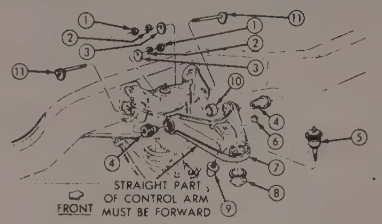
REMOVAL & INSTALLATION

➡Any time the control arm is removed, it is necessary to have the front suspension aligned.

Pick-Up and Ramcharger

➧ See Figure 23

1. Raise and safely support the vehicle on jackstands.
2. Remove the shock absorber.
3. Remove the strut bar and disconnect the sway bar from the lower control arm, if equipped.
4. Install spring compressor tool DD–1278, or equivalent to the coil spring and tighten the nut finger-tight. Then back off half a turn.
5. Remove the cotter pin and upper ball joint nut. Suspend the assembly with a wire so there is not excessive pull on the brake hose.
6. Release the upper ball joint taper using ball stud loosening tool C–3564–A, or equivalent.
7. Remove the tool and remove the ball stud from the control arm.
8. Remove the cam bolt assemblies and remove the arm from the vehicle.
9. Installation is the reverse of removal. Secure all components accordingly.
   - Ball joint nut—135 ft. lbs. (183 Nm)
   - Cam bolts to 70 ft. lbs. (95 Nm)
10. Have the alignment checked at a reputable repair facility.


1
2
3
11
2
3
11
10
6
5
4
7
8
9
STRAIGHT PART OF CONTROL ARM MUST BE FORWARD
FRONT

1. Nut
2. Lockwasher
3. Cam
4. Bushing assembly
5. Ball joint
6. Lock nut
7. Upper control arm
8. Upper ball joint
9. Bumper assembly
10. Sleeve
11. Cam and bolt assembly

88478G16

Fig. 23 Exploded view of the upper control arm assembly—Ram Pick-up and Ramcharger models

Dakota

2WD MODELS

➧ See Figure 24

1. Raise and safely support the vehicle on jackstands.
2. Remove the shock absorber.

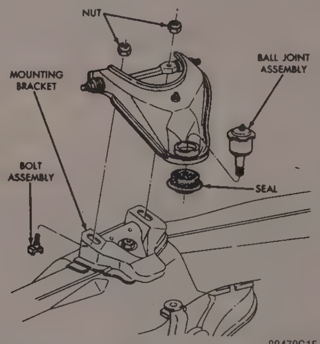

NUT
MOUNTING BRACKET
BALL JOINT ASSEMBLY
BOLT ASSEMBLY
SEAL
88478G15

Fig. 24 Exploded view of the upper control arm assembly—Dakota models

3. Disconnect the sway bar from the lower control arm, if equipped.
4. Install spring compressor tool DD–1278, or equivalent to the coil spring and tighten the nut finger-tight, then back off half a turn.
5. Remove the cotter pin and upper ball joint nut. Suspend the rotor assembly with a wire so there is not excessive pull on the brake hose.
6. Release the upper ball joint taper using ball stud loosening tool C–3564–A, or equivalent.
7. Remove the tool and remove the ball stud from the control arm.
8. Remove the pivot bar retaining bolts and remove the arm from the vehicle.
9. Installation is the reverse of removal. Secure the ball joint nut to 135 ft. lbs. (183 Nm). Install a new cotter pin.
10. Roughly align the front end, then tighten the cam bolts to 155 ft. lbs. (210 Nm).
11. Have the alignment checked at a reputable repair facility.

4WD MODELS

1. Raise and safely support the vehicle on jackstands.
2. Remove the CV driveshaft from the vehicle.
3. Turn the torsion bar adjustment nut counterclockwise to relieve all tension from the torsion bar. Remove the screws that attach the brake hose bracket to the upper arm. Remove the shock absorber.
4. Remove the cotter pin from the upper ball stud, then remove the retaining nut.
5. Release the upper ball joint taper using ball stud loosening tool C–3564–A, or equivalent. Remove the tool. Remove the ball stud from the steering knuckle.
6. Remove the pivot bar retaining bolts.
7. Remove the arm from the vehicle.

To install:

8. Position the arm at the frame rail bracket. Install the pivot arm nuts and bolts.
9. Insert the upper ball stud in the steering knuckle arm bore and install the nut. Tighten the nut to 105 ft. lbs. (142 Nm) and install a new cotter pin. Install the shock absorber and attach the brake hose bracket.

10. Turn the torsion bar adjustment nut clockwise to apply a load on the bar.
11. Install the CV driveshaft and all related parts. Lower the vehicle.
12. Set the front suspension height. The difference between the distance from the surface that the tires are on to the lower control arm inner pivot and the distance that the tires are on to the outer end of the arm is 1–1½ in. (25–38mm).
13. Have the alignment checked at a reputable repair facility.

BUSHING REPLACEMENT

➡1994–96 Pick-ups do not have replaceable bushings.

1. Remove the upper control arm.
2. Place the upper control arm in a vice and assemble Remover/Installer tool No C–3962, or equivalent and adapter No. SP–3953, or equivalent over the bushing. Tighten the nuts and force the bushings out of the arm bore.

To install:

➡Be sure the control arm is supported firmly at the area where the bushing is being forced in. Do not use any lubricant to aid in the installation.

3. Position the flange end of the replacement bushing in the Remover/Installer tool No C–3962, or equivalent. Support the control arm firmly and force the bushing in the control arm bore (from outside). Tighten until the flange end is seated on the arm.
4. Install the control arm.

Lower Control Arm

REMOVAL & INSTALLATION

Pick-Up and Ramcharger

1. Raise and safely support the vehicle on jackstands.
2. Remove the shock absorber.
3. Remove the strut bar and disconnect the sway bar from the lower control arm, if equipped.
4. Install spring compressor tool DD–1278, or equivalent to the coil spring and tighten the nut finger-tight. Then back off half a turn.
5. Remove the cotter pin and lower ball joint nut.
6. Release the lower ball joint taper using ball stud loosening tool C–3564–A, or equivalent.
7. Remove the tool and remove the ball stud from the control arm. Release the compressor tool from the coil spring.
8. Pull the arm down and remove the spring with the rubber isolation pad from the vehicle. Remove the lower control arm pivot bolt from the crossmember and remove the arm from the vehicle.

To install:

9. Install the arm to the crossmember finger-tight. Install the spring with the rubber isolators. Install the compressor tool and compress it enough so the lower ball joint can be inserted through the knuckle.
10. Tighten ¹¹⁄₁₆ lower ball joint nuts to 135 ft. lbs. (183 Nm). Tighten ¾ nuts to 175 ft. lbs. (237 Nm). Install a new cotter pin. Remove the spring compressor.
11. The remainder of installation is the reverse of removal. Tighten each component to specifications.
12. Lower the vehicle completely. When the weight of the vehicle is off of the lifting apparatus, tighten the lower arm pivot bolts to 225 ft. lbs. (305 Nm).
13. Have the alignment checked at a reputable repair facility.

Dakota

2WD MODELS

➧ See Figure 25

1. Raise and safely support the vehicle on jackstands.
2. Remove the shock absorber.
3. Disconnect the sway bar from the lower control arm, if equipped.
4. Install spring compressor tool DD–1278, or equivalent to the coil spring and tighten the nut finger-tight, then back off half a turn.
5. Remove the cotter pin and lower ball joint nut.
6. Release the lower ball joint taper using ball stud loosening tool C–3564–A, or equivalent.

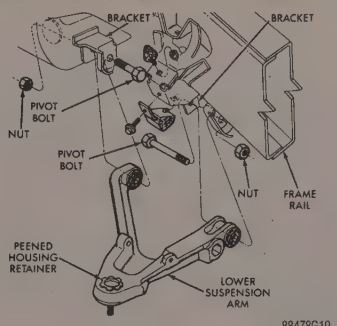


Fig. 25 Exploded view of the lower control arm mounting—Dakota models

7. Remove the tool and remove the ball stud from the control arm. Release the compressor tool from the coil spring.
8. Pull the arm down and remove the spring with the rubber isolation pad from the vehicle. Remove the lower control arm pivot bolts from the crossmember and remove the arm from the vehicle.
9. Installation is the reverse of removal. Secure the lower ball joint nut to 135 ft. lbs. (183 Nm). Install a new cotter pin.
10. Lower the vehicle completely. When the weight of the vehicle is off of the lifting apparatus, tighten the front lower arm pivot bolt to 130 ft. lbs. (176 Nm) and the rear nut to 80 ft. lbs. (108 Nm).
11. Have the alignment checked at a reputable repair facility.

4WD MODELS

1. Raise and safely support the vehicle on jackstands.
2. Remove the CV driveshaft.
3. Remove the torsion bar.
4. Remove the shock absorber lower attaching bolt.
5. Disconnect the stabilizer bar from the lower control arm.
6. Remove the cotter pin and the nut from the lower ball stud. Separate the lower ball stud from the steering knuckle.
7. Remove the pivot bolts and remove the arm from the vehicle.
8. Installation is the reverse of removal. Secure the ball stud into the steering knuckle bore and tighten the nut to 120 ft. lbs. (163 Nm).
9. Lower the vehicle so the weight of the vehicle is completely off of the lifting apparatus.
10. Tighten the front pivot nut to 80 ft. lbs. (108 Nm) and the rear nut to 130 ft. lbs. (176 Nm).
11. Set the front suspension height. The difference between the distance from the surface that the tires are on to the lower control arm inner pivot and the distance that the tires are on to the outer end of the arm is 1–1½ in. (25–38mm).
12. Have the alignment checked at a reputable repair facility.

BUSHING REPLACEMENT

➡The 1994–96 Pick-ups do not have replaceable bushings.

1. Remove the lower control arm.
2. Use an arbor press and an appropriate size sleeve to force the original bushing from the lower control arm.

To install:

3. Use an arbor press and an appropriate size sleeve to force the bushing into the lower control arm bore. Make sure that it is fully seated.
4. Install the lower control arm.

Lower Control Arm Strut

REMOVAL & INSTALLATION

➧ See Figure 26

1. Raise and support the front end on jackstands.
2. Using a small drift and hammer, drive out the spring pin from the front end of the strut.

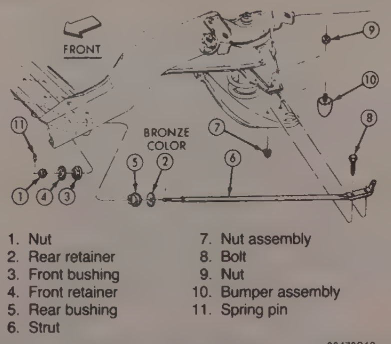

FRONT
BRONZE COLOR
1. Nut
2. Rear retainer
3. Front bushing
4. Front retainer
5. Rear bushing
6. Strut
7. Nut assembly
8. Bolt
9. Nut
10. Bumper assembly
11. Spring pin
88478G12

Fig. 26 Exploded view of the lower control arm strut and related parts—Ram Pick-up and Ramcharger

3. Remove the nut, retainer and bushing.
4. Remove the rear mounting bolts along with the jounce bumper and bracket.
5. Installation is the reverse of removal. Tighten the mounting bracket bolts to 95 ft. lbs. (129 Nm). Tighten the retainer nut to 50 ft. lbs. (68 Nm).

Front Wheel Bearings

REPLACEMENT

See Figures 27, 28, 29, 30 and 31

1. Raise and safely support the vehicle on jackstands.
2. Remove the tire and wheel assembly.
3. Remove the caliper and disc brake pads.
4. Remove the dust cap.
5. Remove the cotter pin, castellated nut lock, wheel bearing nut and washer from the spindle.
6. Remove the outer wheel bearing.
7. Remove the rotor with the inner wheel bearing from the spindle. Remove the grease seal.

To install:

8. Lubricate and install the inner wheel bearing. Install a new grease seal.
9. Install the rotor to the spindle.
10. Lubricate and install the outer wheel bearing, washer and nut. When the bearing preload is properly set, install the nut lock and a new cotter pin. The remainder of installation is the reverse of removal.

ADJUSTMENT

1. Tighten the wheel bearing nut to 20–25 ft. lbs. (27–34 Nm) while turning the rotor.
2. Loosen the wheel bearing adjusting nut completely.
3. Tighten the nut finger-tight.
4. Check the wheel bearing end-play. The specification is 0.001–0.003 in. (0.025–0.076mm).
5. Install the nut lock and cotter pin.

Front End Alignment

STEERING AXIS INCLINATION

➡This applies to independent front suspension only.

Steering axis inclination is the number of degrees that the spindle support centerline is tilted from the true vertical as viewed from the front. It has a fixed relationship with camber and does not change except in the event of damage to a spindle or ball joint. The angle is not adjustable and damaged parts must be replaced.

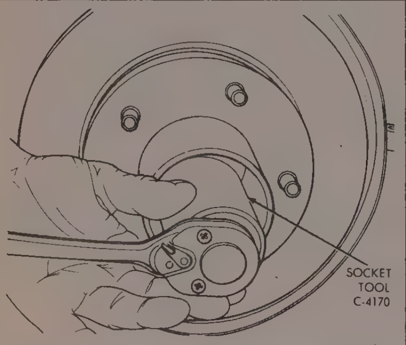

SOCKET TOOL C-4170
88478G30

Fig. 27 Remove the wheel bearing adjusting nut

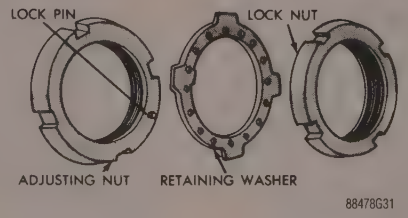

LOCK PIN
LOCK NUT
ADJUSTING NUT
RETAINING WASHER
88478G31

Fig. 28 Exploded view of the bearing retaining hardware used for the 4WD Pick-up and Ramcharger

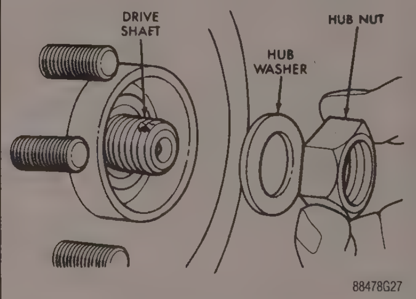

DRIVE SHAFT
HUB NUT
HUB WASHER
88478G27

Fig. 29 Don't forget the hub washer when installing the front wheel bearings

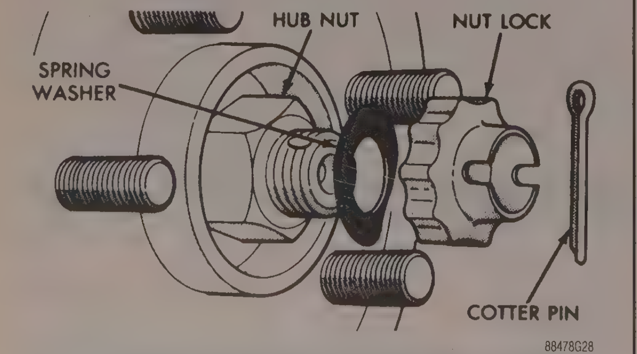

HUB NUT
NUT LOCK
SPRING WASHER
COTTER PIN
88478G28

Fig. 30 This exploded view shows the correct order of installation for the spring washer, nut lock and cotter pin

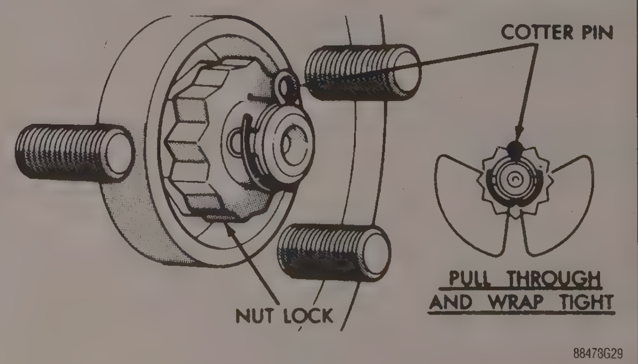

COTTER PIN
PULL THROUGH AND WRAP TIGHT
NUT LOCK
88478G29

Fig. 31 Install a new cotter pin as shown

CAMBER

Camber is expressed as the number of degrees that the top of the wheel is tilted outward or inward from the true vertical when viewed from the front. Inward tilt is negative camber and outward tilt is positive camber. Excessive camber causes premature tire wear; negative camber causes wear on the inside of the tire and positive camber causes the tire to wear on the outside edge.

Camber is adjusted by means of eccentrics at the inner end of the upper control arms. Camber cannot be accurately measured without professional equipment.

CASTER

Caster is the backward or forward tilt from the vertical of the steering knuckle centerline at the top, measured in degrees. A steering knuckle centerline tilted backward has positive (+) caster, while one tilted forward has negative (-) caster. Positive caster produces greater directional stability and requires greater steering effort, since it increases the self-centering effect at the steering wheel.

Caster is adjusted by means of eccentrics at the inner end of the upper control arms. Caster cannot be measured accurately without professional equipment.

TOE-IN

Toe-in is the amount measured in inches, that the centerlines of the wheels are closer together at the front than at the rear. Toe-in must be checked after caster and camber have been adjusted., but it can be adjusted without disturbing the other two settings. You can make this adjustment without special equipment, if you make careful measurements. The adjustment is made at the tie rod sleeves. The wheels must be straight-ahead.

1. Toe-in can be determined by measuring the distance between the centers of the tire treads, front and rear. If the tread pattern makes this impossible, you can measure between the edges of the wheel rims, but make sure to move the truck forward and measure in a couple of places to avoid errors caused by bent rims and wheel runout.
2. Loosen the clamp bolts on the tie rod sleeves.
3. Rotate the sleeves equally (in opposite directions) to obtain the correct measurement. If the sleeves are not adjusted equally, the steering will be crooked. If the steering wheel is already crooked, it can be straightened by turning the sleeves equally in the same direction.
4. When the adjustment is complete, tighten the clamps.

REAR SUSPENSION

Leaf Springs

REMOVAL & INSTALLATION

See Figures 32, 33, 34 and 35

1. Raise the truck and support the rear with jackstands under the frame. Be sure that the front wheels are chocked and that the parking brake is set. The wheels should be touching the floor, but the weight must be off of the springs.
2. Remove the nuts, lockwashers and U-bolts that hold the axle to the springs.
3. Remove the front pivot bolt.
4. Remove the rear shackle bolt nuts and the rear shackle plate.
5. Remove the spring.

To install:

6. Position the spring in place and install the eye bolt and nut. Do not tighten the bolt yet.
7. Install the shackles and bolts. Tighten them just enough to make them snug.
8. Make sure that the spring center bolt enters the locating hole in the axle pad. On headless-type spring bolts, install the bolts with the lock groove lined up with the lockbolt hole in the bracket. Install the lockbolt and tighten the lockbolt nut. Install the lubrication fittings.
9. Install the U-bolts, lockwashers and nuts. Make them just snug for now. Align the auxiliary spring parallel with the main spring.
10. Lower the truck to its normal position with the weight back on the springs. Now tighten all bolts and nuts as follows:

- U-bolt nuts:
- ½ in. nuts—65 ft. lbs. (88 Nm)
- 7/16 in. nuts—110 ft. lbs. (149 Nm)
- Shackle bolts and eye bolts:
- ½ in.—95 ft. lbs. (129 Nm)
- ⅝ in.—125 ft. lbs. (169 Nm)
- ¾ in.—155 ft. lbs. (210 Nm)

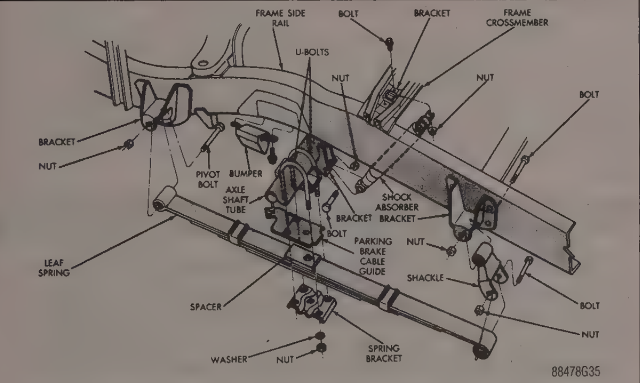

FRAME SIDE RAIL
BOLT
BRACKET
FRAME CROSSMEMBER
U-BOLTS
NUT
NUT
BOLT
BRACKET
NUT
PIVOT BOLT
BUMPER
AXLE SHAFT TUBE
SHOCK ABSORBER
BRACKET
BRACKET
BOLT
PARKING BRAKE CABLE GUIDE
NUT
SHACKLE
LEAF SPRING
SPACER
BOLT
NUT
WASHER
NUT
SPRING BRACKET
88478G35

Fig. 32 Rear spring and shock absorber assembly—2WD Dakota models

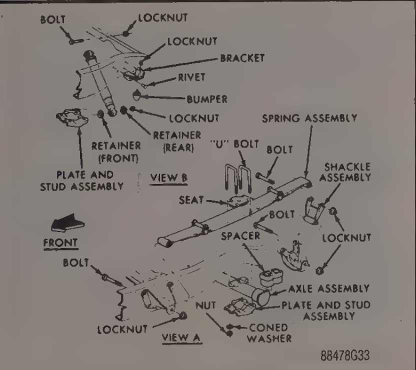

BOLT
LOCKNUT
LOCKNUT
BRACKET
RIVET
BUMPER
LOCKNUT
SPRING ASSEMBLY
RETAINER (FRONT)
RETAINER (REAR)
"U" BOLT
BOLT
PLATE AND STUD ASSEMBLY
VIEW B
SHACKLE ASSEMBLY
SEAT
BOLT
FRONT
SPACER
LOCKNUT
BOLT
AXLE ASSEMBLY
NUT
PLATE AND STUD ASSEMBLY
LOCKNUT
VIEW A
CONED WASHER
88478G33

Fig. 33 Exploded view of the rear suspension—1989–93 Pick-up and Ramcharger

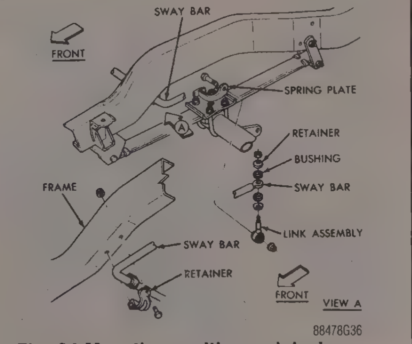

SWAY BAR
FRONT
SPRING PLATE
RETAINER
BUSHING
SWAY BAR
FRAME
LINK ASSEMBLY
SWAY BAR
RETAINER
FRONT
VIEW A
88478G36

Fig. 34 Mounting position and design details of the W-series rear sway bar assembly—1989–93 models

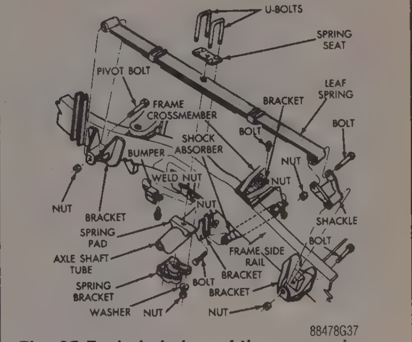

U-BOLTS
SPRING SEAT
LEAF SPRING
PIVOT BOLT
FRAME CROSSMEMBER
BRACKET
BOLT
BOLT
SHOCK ABSORBER
BUMPER
NUT
WELD NUT
NUT
NUT
NUT
BRACKET
SHACKLE
SPRING PAD
BOLT
AXLE SHAFT TUBE
FRAME SIDE RAIL
BRACKET
SPRING BRACKET
BOLT
BRACKET
WASHER
NUT
NUT
88478G37

Fig. 35 Exploded view of the rear spring and shock absorber assembly—4WD Dakota models

Shock Absorbers

REMOVAL & INSTALLATION

➧ See Figures 36, 37 and 38

1. Raise and safely support the truck.
2. Remove the nut from the stud or bolt at the upper end. Remove the stud or bolt from the upper end.
3. Remove the lower nut at the bushing end.
4. Pivot the shock absorber and washers from the lower stud.
5. Remove the shock absorber and washers from the lower stud.
6. Installation is the reverse of removal. Purge the new shock of air by extending it in its normal position and compressing it while inverted. Do this several times. It is normal for there to be more resistance to extension than to compression. Tighten the nuts to 60 ft. lbs. (81 Nm).

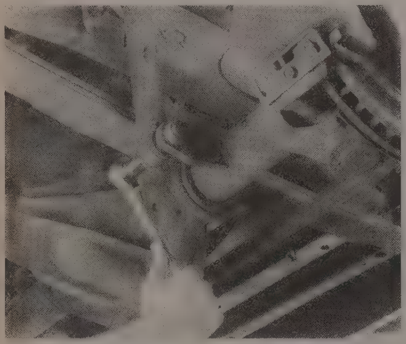


Fig. 36 Unbolt the upper shock mount first . . .

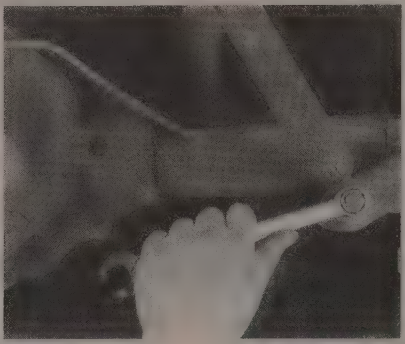


Fig. 37 . . . then unbolt the lower mount to remove the rear shock absorber

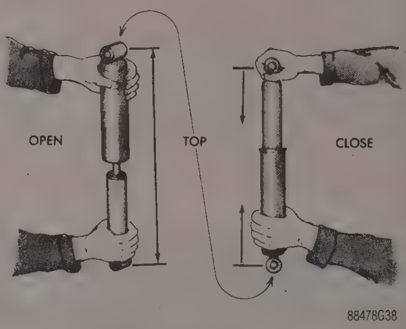


Fig. 38 Purge air as shown from the shock absorbers prior to installation

STEERING

Steering Wheel

REMOVAL & INSTALLATION

1989–93 Models

➧ See Figures 39, 40, 41, 42 and 43

1. Disconnect the battery ground cable.
2. If applicable, unscrew the horn pad from behind the steering wheel.
3. Working through the access holes in the back of the wheel, push the horn pad off. Do NOT pry the pad off!
4. Disconnect the horn wire.
5. Matchmark the steering wheel and shaft.
6. Remove the steering wheel retaining nut.
7. Using a puller, remove the steering wheel from the shaft. NEVER hammer the shaft to free the wheel!
8. Installation is the reverse of removal. Tighten the nut to 45 ft. lbs. (61 Nm).

1994–96 Models

➧ See Figures 44, 45, 46 and 47

➡The DRBII scan tool may be required for this procedure. Steering wheel installation requires the clockspring to be centered to prevent accidental deployment of the air bag module. If the clockspring is not centered, or if the front wheels were moved, the clockspring centering procedure will require the use of the DRBII scan tool to final check the system.

✲✲ CAUTION

Disconnect and isolate the negative (ground) battery cable. This will disable the air bag system. Failure to disconnect the battery could result in accidental deployment and possible personal injury. Allow the system capacitor to discharge for two minutes then begin air bag system component removal. Refer to Section 6 for additional air bag system precautions and information.

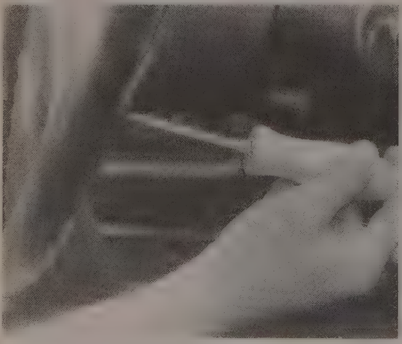


Fig. 39 Remove the steering wheel pad screws from the back of the wheel

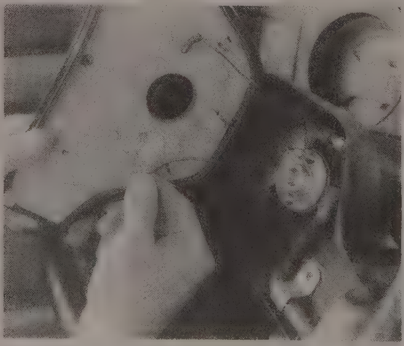


Fig. 40 Unplug the horn's electrical connectors from the steering wheel pad

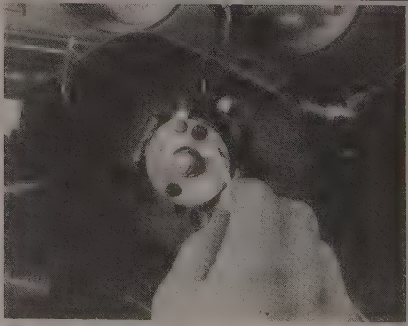


Fig. 41 Use paint or a marker to matchmark the steering wheel shaft and the wheel itself

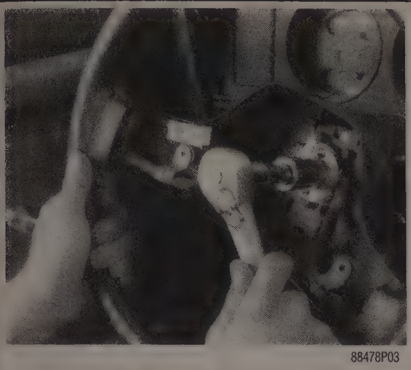


Fig. 42 With the correct socket, remove the steering wheel retaining nut

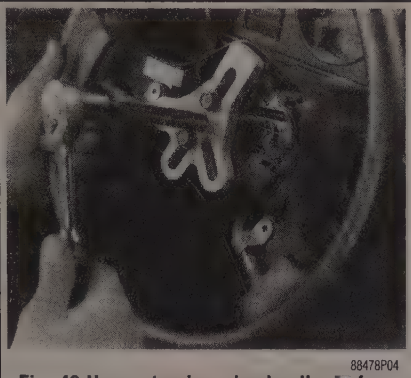


Fig. 43 Use a steering wheel puller to free the wheel from its press-fit on the shaft

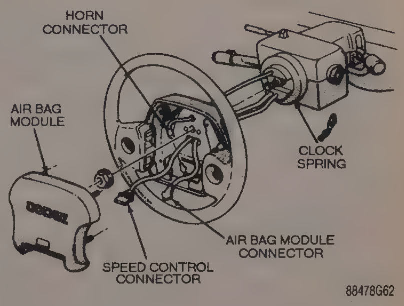

HORN CONNECTOR
AIR BAG MODULE
CLOCK SPRING
AIR BAG MODULE CONNECTOR
SPEED CONTROL CONNECTOR
88478G62

Fig. 44 Exploded view of the air bag steering wheel mounting

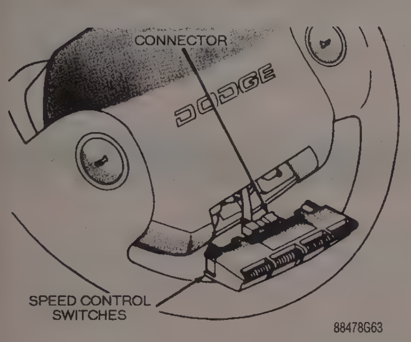

CONNECTOR
DODGE
SPEED CONTROL SWITCHES
88478G63

Fig. 45 Remove 2 screws from behind to detach the speed control switches

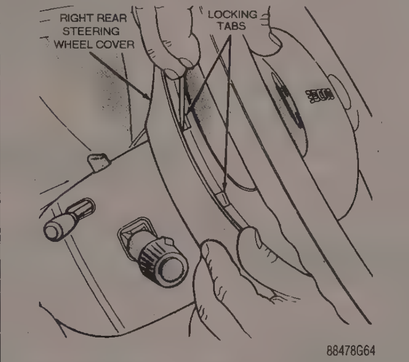

RIGHT REAR STEERING WHEEL COVER
LOCKING TABS
88478G64

Fig. 46 Detach the locking tabs from the right rear steering wheel cover

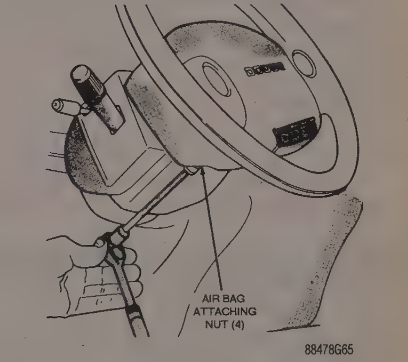

AIR BAG ATTACHING NUT (4)
88478G65

Fig. 47 Unbolt and remove the air bag module

1. Make sure the front wheels are straight and the steering column is locked in place.
2. Disconnect the negative battery cable at the battery and isolate. Wait 2 minutes for the reserve capacitor to discharge before removing non deployed module.
3. Remove the 4 nuts attaching the air bag module from the back side of the steering wheel.
4. Lift the module and unplug the connector from the rear of the module.

➡Refer to Section 6 for precautions concerning the handling of a live air bag module.

5. Remove the vehicle speed control switch and connector, if so equipped, or the cover.
6. Remove the steering wheel retaining nut. The steering wheel and shaft are master splined for installation reference.

To install:

CAUTION

If the clockspring is not properly positioned or if the front wheels were moved, follow the clockspring centering procedure as outlined in Section 6 before installing the steering wheel.

7. Pull the air bag and speed control wires through the lower, larger hole in the steering wheel and horn wire through the smaller hole at the top. Be sure not to pinch the wires.
8. With the front wheels in a straight-ahead position, position the steering wheel on the steering column by aligning the master splines.
9. Install, then tighten the nut to 45 ft. lbs. (61 Nm). Do not attempt to force the wheel onto the shaft. The force of the nut is all that is needed to properly seat the steering wheel.
10. Install the wires to the horn buttons, speed control and air bag module.
11. Connect the clockspring wiring to the module by pressing straight in on the connector. It should latch securely beneath the module locking clip.
12. Mount the air bag module, install the 4 nuts, tightening them to 80–100 inch lbs. (9–11 Nm).
13. Do not connect the negative battery until you perform an Air Bag System Check as outlined in Section 6.

Turn Signal/Hazard Warning Flasher Switch

REMOVAL & INSTALLATION

1989–93 Models

STANDARD COLUMNS

➧ See Figure 48

1. Remove the steering wheel.
2. Remove the turn signal lever retaining screw and remove the lever.

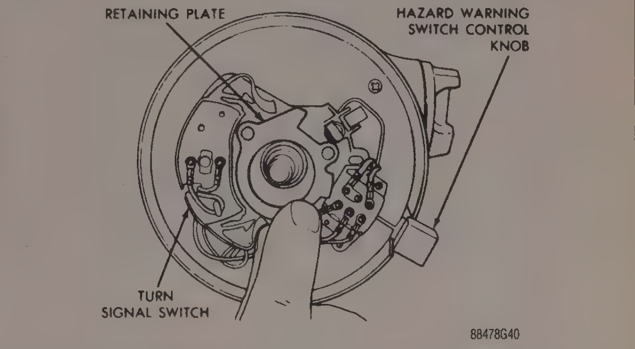

RETAINING PLATE
HAZARD WARNING SWITCH CONTROL KNOB
TURN SIGNAL SWITCH
88478G40

Fig. 48 The turn signal switch retainer and related components

3. Disconnect the turn signal switch wiring at the lower connector.
4. Remove the wiring cover.
5. Remove the snapring from the upper end of the shaft.
6. Remove the screws retaining the turn signal switch and upper bearing.
7. Lift out the turn signal switch and wiring.
8. Installation is the reverse of removal.

TILT COLUMNS

➧ See Figure 49

1. Remove the steering wheel.
2. Depress the lock plate with tool C-4156, or equivalent, just enough to remove the retaining ring, and pry the retaining ring out of the groove.
3. Remove the lock plate and upper bearing spring.
4. Place the turn signal switch in the right turn position.
5. Remove the screw which attaches the link between the turn signal switch and wiper/washer switch pivot.
6. Remove the screw which attaches the hazard switch knob.
7. Remove the 3 screws securing the turn signal switch.
8. Gently pull the switch and wiring from the column.
9. Installation is the reverse of removal.

1994–96 Models

➧ See Figures 50 and 51

➥This unit is called the Multi-Function Switch for 1994–96 models. A special tamper-proof torx® bit will be required for this procedure.

✻✻ CAUTION

Disconnect and isolate the negative (ground) battery cable. This will disable the air bag system. Failure to disconnect the battery could result in accidental deployment and possible personal injury. Allow the system capacitor to discharge for two minutes then begin air bag system component removal. Refer to Section 6 for additional air bag system precautions and information.

1. Disconnect the negative battery cable.
2. If equipped, remove the tilt column lever.
3. On Dakota models, remove the screws along the bottom edge of the knee blocker, then pull it down to disengage the slide tabs and remove the knee blocker from the vehicle.
4. Remove the upper and lower column shrouds.
5. On Dakota models, remove the lower fixed column shroud. Loosen, but do not remove, the steering column upper bracket nuts so as to be able to move the upper fixed column shroud to gain access to the multi-function switch.
6. Using a Snap-On® TTXR20B2, or equivalent, tamper-proof torx® bit, remove the multi-function switch mounting screws.
7. Gently pull the switch away, loosen the connector screw, then remove the wiring connector from the switch. The screw will remain with the connector.
8. Installation is the reverse of removal. Secure the wiring connector to the switch, the screw should be tightened to 17 inch lbs. (2 Nm).
9. Mount the multi-function switch to the column, tightening the remaining screws to 17 inch lbs. (2 Nm).
10. On Dakota models, position the upper fixed column shroud. Tighten the steering column upper bracket nuts to 110 inch lbs. (12 Nm). Install the lower fixed shroud.

Ignition Switch

REMOVAL & INSTALLATION

Standard Columns

➧ See Figures 52 and 53

1. Remove the steering wheel.
2. Remove the turn signal switch.

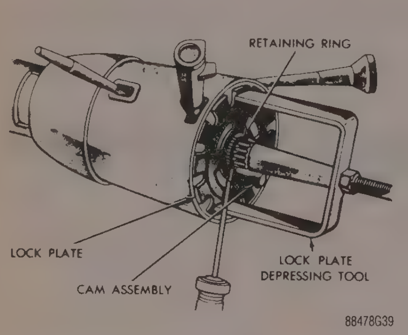

RETAINING RING
LOCK PLATE
LOCK PLATE DEPRESSING TOOL
CAM ASSEMBLY
88478G39

Fig. 49 Use a suitable tool to depress the lock plate

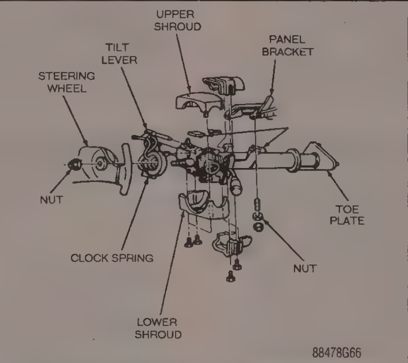

UPPER SHROUD
TILT LEVER
PANEL BRACKET
STEERING WHEEL
NUT
TOE PLATE
CLOCK SPRING
NUT
LOWER SHROUD
88478G66

Fig. 50 Exploded view of the steering column shroud and related components

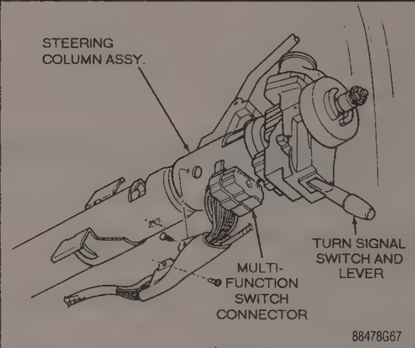

STEERING COLUMN ASSY.
TURN SIGNAL SWITCH AND LEVER
MULTI-FUNCTION SWITCH CONNECTOR
88478G67

Fig. 51 The connector is secured to the switch with a screw

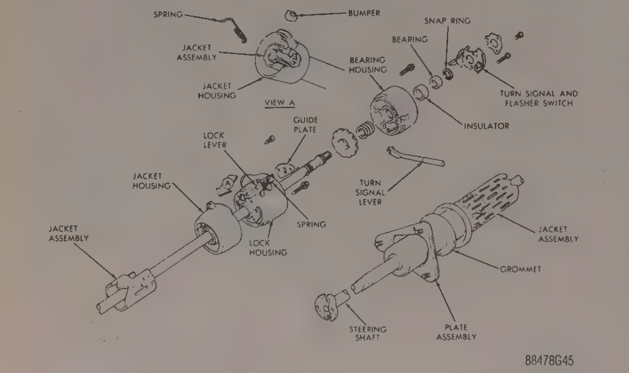

SPRING
BUMPER
SNAP RING
BEARING
JACKET ASSEMBLY
BEARING HOUSING
JACKET HOUSING
TURN SIGNAL AND FLASHER SWITCH
VIEW A
INSULATOR
GUIDE PLATE
LOCK LEVER
JACKET HOUSING
TURN SIGNAL LEVER
SPRING
JACKET ASSEMBLY
JACKET ASSEMBLY
LOCK HOUSING
GROMMET
STEERING SHAFT
PLATE ASSEMBLY
88478G45

Fig. 52 Exploded view of a typical steering column with floor shift

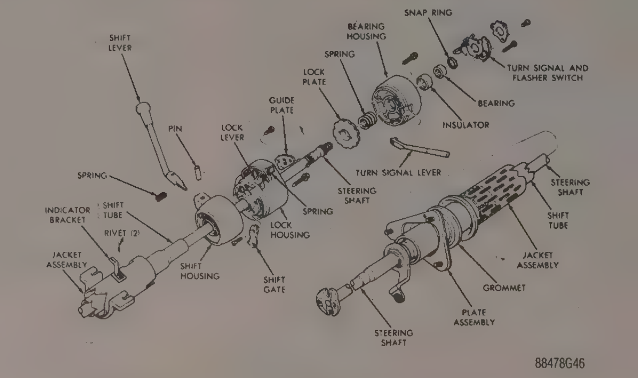

SNAP RING
BEARING HOUSING
SHIFT LEVER
SPRING
TURN SIGNAL AND FLASHER SWITCH
LOCK PLATE
BEARING
GUIDE PLATE
INSULATOR
PIN
LOCK LEVER
TURN SIGNAL LEVER
SPRING
STEERING SHAFT
STEERING SHAFT
INDICATOR BRACKET
SHIFT TUBE
SPRING
SHIFT TUBE
RIVET (2)
LOCK HOUSING
JACKET ASSEMBLY
JACKET ASSEMBLY
SHIFT HOUSING
SHIFT GATE
GROMMET
PLATE ASSEMBLY
STEERING SHAFT
88478G46

Fig. 53 Exploded view of a typical steering column with column shift

3. Remove the retaining screw and lift the ignition lock cylinder lamp out of the way.
4. Remove the bearing housing.
5. Remove the coil spring.
6. Remove the lock plate from the shaft.
7. Remove the 2 retaining screws and lift the lock lever guide plate to expose the lock cylinder release hole.
8. Insert the key and place the lock cylinder in the **LOCK** position. Remove the key.
9. Insert a thin punch into the lock cylinder release hole and push inward to release the spring-loaded lock retainer. At the same time, pull the lock cylinder out of the column.
10. Remove the 3 retaining screws and lift out the ignition switch.

To install:

11. Position the ignition switch in the center detent position (**OFF**).
12. Place the shift lever in PARK.
13. Feed the wires down through the space between the housing and jacket. Position the switch in the housing and install the 3 retaining screws.
14. Place the lock cylinder in the **LOCK** position and press it into place in the column. It will snap into position.
15. The remainder of assembly is the reverse of disassembly.

Tilt Columns

1. Remove the steering wheel.
2. Remove the tilt lever and turn signal lever.
3. If equipped, remove the turn signal lever.
4. Remove the turn signal switch.
5. Using the key, place the lock cylinder in the **LOCK** position. Remove the key.
6. Insert a thin punch in the slot next to the switch mounting screw boss and depress the spring latch at the bottom of the slot. Hold the spring latch depressed and pull the lock cylinder out of the column.
7. Place the ignition switch in the **ACCESSORY** position and remove the mounting screws. Lift off the switch. The **ACCESSORY** position is the one opposite the spring-loaded end position.

To install:

8. First, install the lock cylinder. Place the cylinder in the **LOCK** position and push it into the housing. It will snap into place.
9. Rotate the lock cylinder to the **ACCESSORY** position.
10. Fit the actuator rod in the slider hole and position the switch on the column. Insert the mounting screws, but don't tighten them yet.
11. Push the switch gently down the column to remove all lash from the actuator rod. Tighten the mounting screws. Make sure that you didn't take the switch out of the **ACCESSORY** detent!
12. The remainder of installation is the reverse of removal.

Ignition Lock Cylinder

REMOVAL & INSTALLATION

1989–91 Models

STANDARD COLUMNS

1. Remove the steering wheel.
2. Remove the turn signal switch.
3. Remove the retaining screw and lift the ignition lock cylinder lamp out of the way.
4. Remove the bearing housing.
5. Remove the coil spring.
6. Remove the lock plate from the shaft.
7. Remove the 2 retaining screws and lift the lock lever guide plate to expose the lock cylinder release hole.
8. Insert the key and place the lock cylinder in the **LOCK** position. Remove the key.
9. Insert a thin punch into the lock cylinder release hole and push inward to release the spring-loaded lock retainer. At the same time, pull the lock cylinder out of the column.
10. When installing the lock cylinder, make sure it is in the **LOCK** position. Press it into the column. It will snap into place. The remainder of assembly is the reverse of disassembly.

TILT COLUMNS

1. Remove the steering wheel.
2. Remove the tilt lever and turn signal lever.
3. Remove the turn signal switch.
4. Using the key, place the lock cylinder in the **LOCK** position. Remove the key.
5. Insert a thin punch in the slot next to the switch mounting screw boss and depress the spring latch at the bottom of the slot. Hold the spring latch depressed and pull the lock cylinder out of the column.
6. To install, place the lock cylinder in the **LOCK** position and press it into place in the column. It will snap into position. The remainder of assembly is the reverse of disassembly.

1992–96 Models

➧ See Figures 54, 55, 56 and 57

✲✲ CAUTION

Disconnect and isolate the negative (ground) battery cable. This will disable the air bag system. Failure to disconnect the battery could result in accidental deployment and possible personal injury. Allow the system capacitor to discharge for two minutes then begin air bag system component removal. Refer to Section 6 for additional air bag system precautions and information.

1. Disconnect the negative battery cable.
2. If equipped with a tilt column, remove the tilt lever by turning it counterclockwise.
3. Remove the upper and lower covers from the column.
4. Remove the ignition switch mounting screws. Use a tamper resistant Torx® bit (Snap-On® TTXR20A2, or equivalent) to remove the screws.
5. Pull the switch away from the column Release the connector locks on the 7 terminal wiring connector, then remove the connector from the ignition switch.
6. Release the connector lock on the 4 terminal wiring connector, then remove the connector from the ignition switch.
7. Turn the key to the **LOCK** position. Using a TTXR20A2, or equivalent, remove the key cylinder retaining screw and bracket.
8. Rotate the key clockwise to the **OFF** position. The key cylinder will unseat from the ignition switch. When the key cylinder is unseated, it will be approximately ⅛ in. (3mm) away from the ignition switch halo light ring. DO NOT attempt to remove the key cylinder at this time.
9. With the key cylinder in the unseated position, rotate the key counterclockwise to the **LOCK** position and remove the key.
10. Remove the key cylinder from the ignition switch.

To install:

11. Engage the electrical connectors to the ignition switch and make sure the switch locking tabs are fully seated.
12. Before attaching the ignition switch to a tilt steering column, the transmission shifter must be in the PARK position. Also the park lock dowel pin and the column lock flag must be properly indexed before installing the switch as follows:
    a. Place the transmission shifter in the PARK position
    b. Place the ignition switch in the **LOCK** position. The switch is in the lock position when the column lock flag is parallel to the ignition switch terminals.
    c. Position the ignition switch park lock dowel pin so it will engage the steering column park lock slider linkage.
    d. Apply a light coating of grease to the column lock flag and the park lock dowel pin.
13. Place the ignition switch against the lock housing opening on the steering column. Ensure that the ignition switch park lock dowel pin enters the slot in the park lock slider linkage in the steering column.
14. Install the retaining bracket and ignition switch mounting screws, then tighten the screws to 22–30 inch lbs. (3–4 Nm).
15. If the vehicle is equipped with a tilt steering column, install the tilt lever.
16. With the key cylinder and the ignition switch in the **LOCK** position, insert the key cylinder into the ignition switch until it bottoms.
17. Insert the ignition key into the lock cylinder. While pushing the key cylinder in toward the ignition switch, rotate the ignition key until the end of travel.

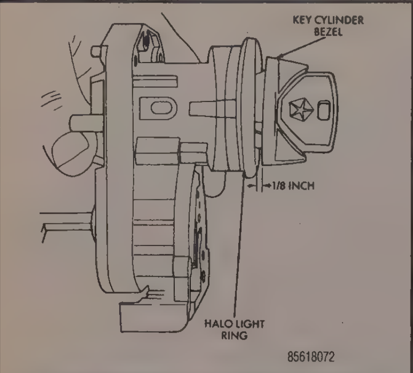

KEY CYLINDER BEZEL
1/8 INCH
HALO LIGHT RING
85618072

Fig. 54 Unseated key cylinder—1992–96 models

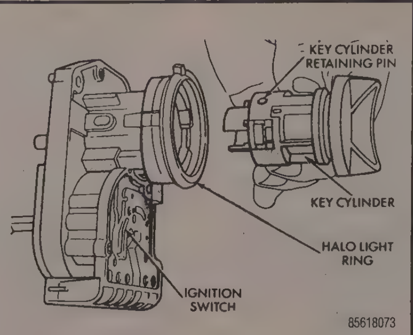

KEY CYLINDER RETAINING PIN
KEY CYLINDER
HALO LIGHT RING
IGNITION SWITCH
85618073

Fig. 55 The key cylinder is mounted in the ignition switch housing—1992–96 models

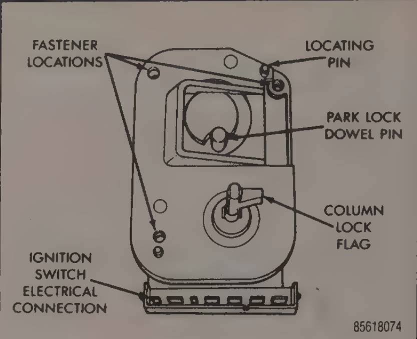

FASTENER LOCATIONS
LOCATING PIN
PARK LOCK DOWEL PIN
COLUMN LOCK FLAG
IGNITION SWITCH ELECTRICAL CONNECTION
85618074

Fig. 56 Ignition switch view from the column—1992–96 models

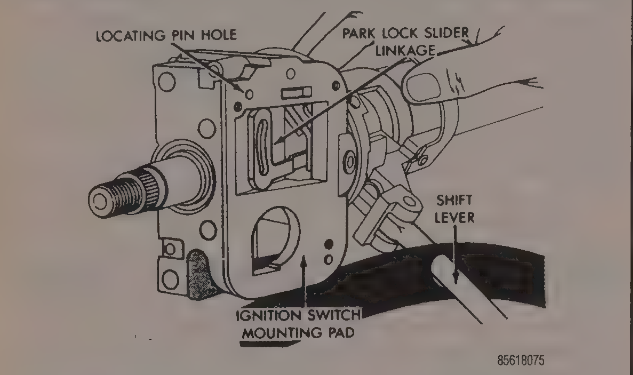
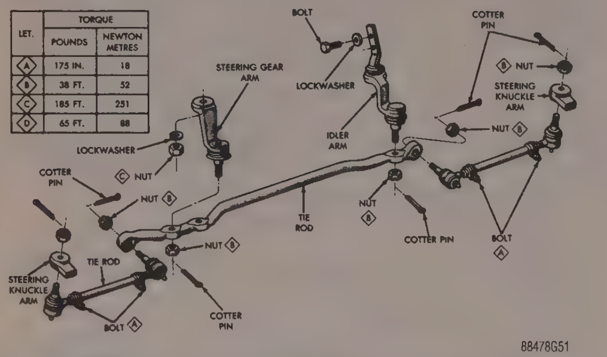

LOCATING PIN HOLE
PARK LOCK SLIDER LINKAGE
SHIFT LEVER
IGNITION SWITCH MOUNTING PAD
85618075

Fig. 57 Ignition switch mounting pad—1992–96 models



LET.	TORQUE	
	POUNDS	NEWTON METRES
A	175 IN.	18
B	38 FT.	52
C	185 FT.	251
D	65 FT.	88

BOLT
COTTER PIN
STEERING GEAR ARM
LOCKWASHER
B NUT
STEERING KNUCKLE ARM
IDLER ARM
NUT B
LOCKWASHER
COTTER PIN
C NUT
NUT B
TIE ROD
NUT B
TIE ROD
COTTER PIN
BOLT A
NUT B
STEERING KNUCKLE ARM
BOLT A
COTTER PIN
88478G51

Fig. 58 Exploded view of the steering linkage assembly—4WD Dakota models

18. Install the retaining screw into the bracket and lock cylinder and tighten to 22–30 inch lbs. (3–4 Nm).
19. Install the steering column covers, then the tilt lever, if equipped.
20. Connect the negative battery cable.
21. Check for proper operation.

Steering Linkage

See Figure 58

REMOVAL & INSTALLATION

Tie Rod Ends

See Figures 59, 60 and 61

1. Raise and safely support the vehicle on jackstands.
2. Remove the cotter pin and nut from the tie rod end.
3. Using a suitable puller, remove the tie rod from the steering knuckle of center link.

➡Either count the number of visible threads or paint an alignment reference mark before unscrewing the end from the tie rod. This should enable you to thread the tie rod end back to NEAR the original position. Even if this is done, a front end alignment check should still be performed.

4. Loosen the sleeve clamp nut and bolt and unscrew the tie rod end from the sleeve.
5. Installation is the reverse of removal. Install the tie rod end in the sleeve. Screw it in as many turns as the tie rod end was when removed (or to the painted mark).
6. Install the tie rod end into the steering knuckle. Install the castellated nut, tightening it to 45 ft. lbs. (61 Nm). Always install a new cotter pin.
7. Have the alignment checked at a reputable repair facility.

Fig. 59 Remove the cotter pin and discard

Fig. 60 Use the correct socket or wrench to remove the castellated nut from the tie rod end

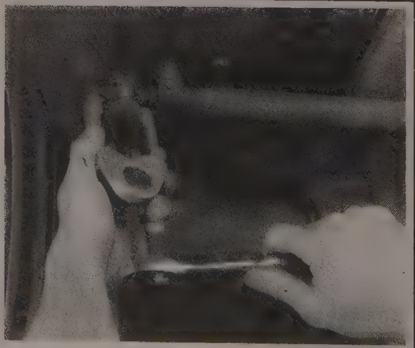


Fig. 61 Use a tie rod puller to separate the link

Pitman Arm

1. Place the wheels in a straight-ahead position.
2. Disconnect the drag link at the pitman arm. You'll need a puller such as a tie rod end remover.
3. Remove the pitman arm-to-gear nut and washer.
4. Matchmark the pitman arm and gear housing for installation purposes.
5. Using a 2-jawed puller, remove the pitman arm from the gear.

To install:

6. With the wheels in the straight-ahead position, install the pitman arm up to the matchmarks made previously and restore it to its correct mounted position.
7. Tighten the pitman arm nut to 175 ft. lbs. (237 Nm). Tighten the drag link ball stud nut to 40 ft. lbs., advancing the nut to align the cotter pin hole. Never back off the nut to align the hole.

Tie Rod and Drag Link

See Figure 52

Drag link seals should be inspected for damage at all oil change intervals.

Damaged seals require removal of the seals and inspection of the drag link assembly at the throat opening. If the parts have not lost all the lubricant or are not contaminated, worn or rusted, use new seals and reinstall. Otherwise a completely new drag link assembly should be installed.

1. Raise and safely support the vehicle (at a comfortable working height. Remove the interfering wheel from the vehicle.
2. Turn the wheels in a direction that will give the best access to the drag link.
3. Remove the cotter pins and nuts from the drag link. Install puller tool C–4150, or equivalent, to free the drag link from the steering gear arm.
4. Lower the drag link from the vehicle.

To install:

5. Position the drag link to the steering knuckle arm so that from the bend in the arm to the knuckle is the short distance marked as "A" (see illustration). The long distance from the bend (marked "B") is to be installed in the steering gear arm.
6. Seat the studs in the tapered hole before tightening the nuts. This will avoid wrap-up of the rubber grommets during tightening of the nuts. Tighten the nuts to 60 ft. lbs. (81 Nm). Always use new cotter pins.
7. Install the wheel. Carefully lower the vehicle.

Connecting Rod

1. Raise and support the front end on jackstands.
2. Place the wheels in the straight-ahead position.
3. Disconnect the connecting rod from the drag link by removing the nut and separating the two with a tie rod end remover.
4. Loosen the bolts on the adjusting sleeve clamps. Count the number of turns it takes to remove the connecting rod from the adjuster sleeve and remove the rod.
5. Installation is the reverse of removal. Install the connecting rod the exact number of turns noted during removal. Tighten the nuts to 40 ft. lbs. (55 Nm).
6. Have the alignment checked at a reputable repair facility.

Manual Steering Gear

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Remove the 2 bolts from the wormshaft to steering shaft coupler.
3. Raise and safely support the vehicle on jackstands.
4. Matchmark, then remove the pitman arm from the pitman shaft. Use tool C–4150, or equivalent.
5. Remove the steering gear mounting bolts and remove the gear from the vehicle.
6. The installation is the reversal of the removal procedure. Tighten the pitman arm nut to 175 ft. lbs. (237 Nm).

Manual Rack and Pinion Steering Gear

REMOVAL & INSTALLATION

Dakota

See Figure 53

This procedure applies to 2WD Dakota models only.

1. Disconnect the negative battery cable.
2. Remove the tie rod ends from the steering knuckle.
3. Remove the coupling pin.
4. Remove the bolts attaching the rack to the crossmember.
5. Remove the gear from the vehicle.
6. The installation is the reverse of the removal procedure. Tighten the mounting bolts to 150 ft. lbs. (203 Nm).

Power Rack and Pinion Steering Gear

REMOVAL & INSTALLATION

Dakota

See Figure 64

This procedure applies to 2WD Dakota models only.

1. Disconnect the negative battery cable.
2. Remove the tie rod ends from the steering knuckle.
3. Disconnect and plug the power steering fluid lines.
4. Remove the coupling pin.
5. Remove the bolts attaching the rack to the crossmember.
6. Remove the gear from the vehicle.
7. The installation is the reverse of the removal procedure. Tighten the mounting bolts to 150 ft. lbs. (203 Nm). Refill the power steering pump.

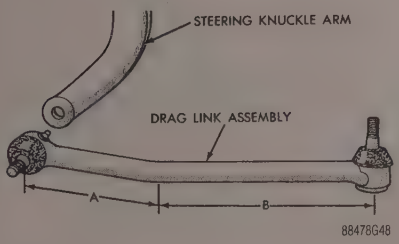


Fig. 52 Reference marks for installing the drag link

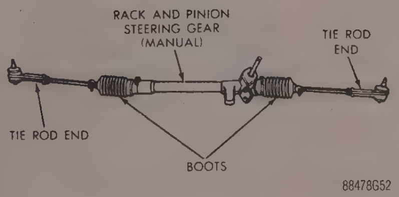


Fig. 63 Details of the manual rack-and-pinion unit—2WD Dakota models

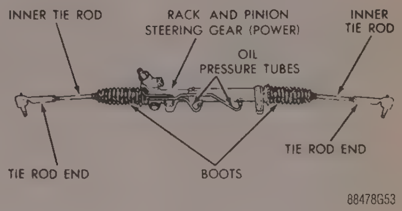


Fig. 64 Details of the power rack-and-pinion unit—2WD Dakota models

Power Steering Gear

REMOVAL & INSTALLATION

Pick-Up and Ramcharger

1. Place the wheels in the straight-ahead position.
2. Remove the windshield washer solvent reservoir and the coolant overflow tank, if necessary.
3. Position a drain pan under the steering gear.
4. Disconnect the fluid hoses from the gear and plug them.
5. Raise and safely support the vehicle on jackstands. Matchmark and remove the pitman arm.
6. Disconnect the steering column shaft from the stub shaft.
7. Remove the retaining bolts and remove the steering gear from the vehicle.
8. Installation is the reversal of the removal procedure. Tighten the pitman arm nut to 175 ft. lbs. (237 Nm).

4WD Dakota

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle on jackstands. Center the steering.
3. Disconnect the pitman arm from the center link.
4. Disconnect and plug the pressure and return hoses.
5. Disconnect the steering gear-to-shaft coupling.
6. Remove the steering gear mount bolts and remove the gear from the vehicle.
7. Matchmark and remove the pitman arm from the sector shaft.
8. Installation is the reverse of the removal procedure. Tighten the pitman arm nut to 175 ft. lbs. (237 Nm) and the mount bolts to 100 ft. lbs. (136 Nm). Refill the power steering pump.

Power Steering Pump

REMOVAL & INSTALLATION

➧ See Figure 65

1. Disconnect the negative battery cable.
2. Position a drain pan under the power steering pump.

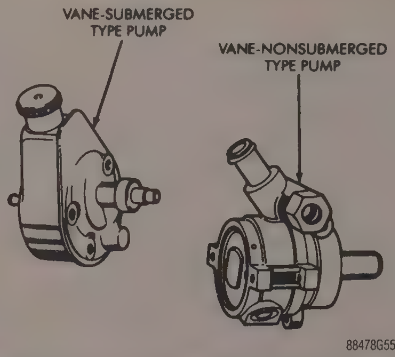


Fig. 65 Common design of the vane-submerged and non-submerged power steering pumps

3. Disconnect the fluid hoses from the pump and plug them.
4. Remove the front bracket attaching bolts and remove the belt from the pulley.
5. Remove the rear pump to bracket nut and remove the pump.
6. Remove the bracket from the pump.
7. Remove the pulley from the pump with the proper puller. Install the pulley on the new pump using the special installation tools.
8. Installation is the reversal of the removal procedure.

SYSTEM BLEEDING

1. Fill the reservoir with power steering fluid.
2. Turn the wheels to the full left turn position and add fluid until the reservoir is full.
3. Start the engine and add fluid to bring the level to the correct level.
4. To purge the system of air, turn the steering wheel from side to side without contacting the stops.
5. Return the wheel to the straight-ahead position and operate the engine for 2 minutes before road testing. This should bleed the system completely.

TORQUE SPECIFICATIONS

Component/Model Year	US (Foot Pounds*)	Metric (Newton Meters)
1989-93 Pick-up and Ramcharger Models		
Differential housing cover bolt (Model 44 axle)	20	27
Ball stud nut		
Lower		
AD150, D150, D250	135	183
D350	225	305
Upper		
D150, D250, D350	135	183
D350	225	305
Brake support-to-steering knuckle bolt		
AD150, D150, D250	215	291
D350	225	305
Drive pinion gear shaft yoke nut	210	285
Differential bearing cap bolt	80	108
Lower suspension arm bolt	210	285
Driveshaft U-joint clamp screw		
AW150, W150, W250	170 inch lbs.	19
W350	300 inch lbs.	34
Shock absorber lower nut		
AD150, D150, D250, D350	200 inch lbs.	23
AW150, W150, W250 with Model 44 axle	55	75
W250, W350 with Model 60 axle	55	75
Shock absorber upper nut		
AD150, D150, D250, D350	25	34
AW150, W150, W250 with Model 44 axle	55	75
W250, W350 with Model 60 axle	55	75
Spring U-bolt nut	110	149
Steering linkage ball stud nut		
AD150, D150, D250, D350	47	64
D350	55	55
AW150, W150, W250, W350	60	81
Strut nut (front)		
AD150, D150, D250, D350	50	68
Strut nut (rear)		
AD150, D150, D250, D350	85	115
Tie rod clamp nut		
AD150, D150, D250, D350	160 inch lbs.	18
Tie rod end ball stud nut		
2WD	40	54
4WD	60	81
Stabilizer bar		
2WD		
At frame	270 inch lbs.	31
At link	100 inch lbs.	11
Upper suspension arm cam bolt (2WD)	70	95

88478C11

TORQUE SPECIFICATIONS

Component/Model Year	US (Foot Pounds*)	Metric (Newton Meters)
1994-96 Ram Models With Wax Coat Frame--Front Suspension		
Shock absorber		
Upper nut	30	41
Lower bolt	100	135
Lower suspension arm		
Frame nuts	110	149
Ball stud nut	55	75
Upper suspension arm		
Pivot bar nuts	150	203
Ball stud nut	55	75
Stabilizer bar		
Clamp bolt	35	47
Link nuts	25	34
1994-96 Ram Models With E-Coat Frame--Front Suspension		
Shock absorber		
Upper nut	30	41
Lower bolt	100	135
Lower suspension arm		
Frame nuts	200	271
Ball stud nut	55	75
Upper suspension arm		
Pivot bar nuts	200	271
Ball stud nut	55	75
Stabilizer bar		
Clamp bolt	45	61
Link nuts	25	34
1994-96 Ram Models With Wax Coat Frame--Rear Suspension		
Shock absorber		
Upper nut	100	136
Lower bolt	70	95
Spring clamp nuts		
6010-10,500 GVW	110	149
11,000 GVW Cab-Chassis	120	163
Spring front and rear eye		
Bolt/nut 6010-7500 GVW	150	203
Bolt/nut 8800-11,000GVW	210	285
Jounce bumper		
Bolts	33	45
1994-96 Ram Models With E-Coat Frame--Rear Suspension		
Shock absorber		
Upper nut	100	136
Lower bolt	110	149
Spring clamp nuts		
6010-10,500 GVW	110	149
11,000 GVW Cab-Chassis	120	163
Spring front and rear eye		
Bolt/nut 6010-7500 GVW	150	203
Bolt/nut 8800-11,000GVW	200	271
Jounce bumper		
Bolts	45	61

88478C12

TORQUE SPECIFICATIONS

Component/Model Year	US (Foot Pounds*)	Metric (Newton Meters)
2WD Dakota Models--Front Suspension		
Shock absorber		
Upper nut	30	41
Lower bolt	200 inch lbs.	23
Lower suspension arm		
Front nut	130	176
Rear nut	80	108
Ball stud nut	135	183
Upper suspension arm		
Pivot bar nuts	155	210
Ball stud nut	105	142
Stabilizer bar		
Clamp bolt	40	54
Link nuts	17	23
Support bracket bolts	22.5	30
4WD Dakota Models--Front Suspension		
Shock absorber		
Upper nut	30	41
Lower bolt	100	136
Lower suspension arm		
Front bolt	80	108
Rear bolt	130	176
Ball stud nut	115	156
Upper suspension arm		
Pivot bar bolts	155	210
Ball stud nut	105	142
Stabilizer bar		
Clamp bolt	20	27
Retainer bolts	20	27
Support bracket bolts	20	27
Wheel hub/bearing bolts	110	149
Dakota Models--Rear Suspension		
Shock absorber		
Lower bolt	65	88
Upper bolt	20	27
Spring clamp nut		
2WD	65	88
4WD	110	149
Spring		
Spring eye nut	65	88
Pivot bolt nut	65	88

*Unless otherwise specified in the column. To convert inch pounds to foot pounds, divide the inch pounds by 12

88478C13

9

BRAKES

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BRAKE OPERATING SYSTEM

Basic Operating Principles

Hydraulic systems are used to actuate the brakes of all modern automobiles. The system transports the power required to force the frictional surfaces of the braking system together from the pedal to the individual brake units at each wheel. A hydraulic system is used for two reasons.

First, fluid under pressure can be carried to all parts of an automobile by small pipes and flexible hoses without taking up a significant amount of room or posing routing problems.

Second, a great mechanical advantage can be given to the brake pedal end of the system, and the foot pressure required to actuate the brakes can be reduced by making the surface area of the master cylinder pistons smaller than that of any of the pistons in the wheel cylinders or calipers.

The master cylinder consists of a fluid reservoir along with a double cylinder and piston assembly. Double type master cylinders are designed to separate the front and rear braking systems hydraulically in case of a leak. The master cylinder coverts mechanical motion from the pedal into hydraulic pressure within the lines. This pressure is translated back into mechanical motion at the wheels by either the wheel cylinder (drum brakes) or the caliper (disc brakes).

Steel lines carry the brake fluid to a point on the vehicle's frame near each of the vehicle's wheels. The fluid is then carried to the calipers and wheel cylinders by flexible tubes in order to allow for suspension and steering movements.

In drum brake systems, each wheel cylinder contains two pistons, one at either end, which push outward in opposite directions and force the brake shoe into contact with the drum.

In disc brake systems, the cylinders are part of the calipers. At least one cylinder in each caliper is used to force the brake pads against the disc.

All pistons employ some type of seal, usually made of rubber, to minimize fluid leakage..A rubber dust boot seals the outer end of the cylinder against dust and dirt. The boot fits around the outer end of the piston on disc brake calipers, and around the brake actuating rod on wheel cylinders.

The hydraulic system operates as follows: When at rest, the entire system, from the piston(s) in the master cylinder to those in the wheel cylinders or calipers, is full of brake fluid. Upon application of the brake pedal, fluid trapped in front of the master cylinder piston(s) is forced through the lines to the wheel cylinders. Here, it forces the pistons outward, in the case of drum brakes, and inward toward the disc, in the case of disc brakes. The motion of the pistons is opposed by return springs mounted outside the cylinders in drum brakes, and by spring seals, in disc brakes.

Upon release of the brake pedal, a spring located inside the master cylinder immediately returns the master cylinder pistons to the normal position. The pistons contain check valves and the master cylinder has compensating ports drilled in it. These are uncovered as the pistons reach their normal position. The piston check valves allow fluid to flow toward the wheel cylinders or calipers as the pistons withdraw. Then, as the return springs force the brake pads or shoes into the released position, the excess fluid reservoir through the compensating ports. It is during the time the pedal is in the released position that any fluid that has leaked out of the system will be replaced through the compensating ports.

Dual circuit master cylinders employ two pistons, located one behind the other, in the same cylinder. The primary piston is actuated directly by mechanical linkage from the brake pedal through the power booster. The secondary piston is actuated by fluid trapped between the two pistons. If a leak develops in front of the secondary piston, it moves forward until it bottoms against the front of the master cylinder, and the fluid trapped between the pistons will operate the rear brakes. If the rear brakes develop a leak, the primary piston will move forward until direct contact with the secondary piston takes place, and it will force the secondary piston to actuate the front brakes. In either case, the brake pedal moves farther when the brakes are applied, and less braking power is available.

All dual circuit systems use a switch to warn the driver when only half of the brake system is operational. This switch is usually located in a valve body which is mounted on the firewall or the frame below the master cylinder. A hydraulic piston receives pressure from both circuits, each circuit's pressure being applied to one end of the piston. When the pressures are in balance, the piston remains stationary. When one circuit has a leak, however, the greater pressure in that circuit during application of the brakes will push the piston to one side, closing the switch and activating the brake warning light.

In disc brake systems, this valve body also contains a metering valve and, in some cases, a proportioning valve. The metering valve keeps pressure from traveling to the disc brakes on the front wheels until the brake shoes on the rear wheels have contacted the drums, ensuring that the front brakes will never be used alone. The proportioning valve controls the pressure to the rear brakes to lessen the chance of rear wheel lock-up during very hard braking.

Warning lights may be tested by depressing the brake pedal and holding it while opening one of the wheel cylinder bleeder screws. If this does not cause the light to go on, substitute a new lamp, make continuity checks, and, finally, replace the switch as necessary.

The hydraulic system may be checked for leaks by applying pressure to the pedal gradually and steadily. If the pedal sinks very slowly to the floor, the system has a leak. This is not to be confused with a springy or spongy feel due to the compression of air within the lines. If the system leaks, there will be a gradual change in the position of the pedal with a constant pressure.

Check for leaks along all lines and at wheel cylinders. If no external leaks are apparent, the problem is inside the master cylinder.

DISC BRAKES

Instead of the traditional expanding brakes that press outward against a circular drum, disc brake systems utilize a disc (rotor) with brake pads positioned on either side of it. An easily-seen analogy is the hand brake arrangement on a bicycle. The pads squeeze onto the rim of the bike wheel, slowing its motion. Automobile disc brakes use the identical principle but apply the braking effort to a separate disc instead of the wheel.

The disc (rotor) is a casting, usually equipped with cooling fins between the two braking surfaces. This enables air to circulate between the braking surfaces making them less sensitive to heat buildup and more resistant to fade. Dirt and water do not drastically affect braking action since contaminants are thrown off by the centrifugal action of the rotor or scraped off the by the pads. Also, the equal clamping action of the two brake pads tends to ensure uniform, straight line stops. Disc brakes are inherently self-adjusting. There are three general types of disc brake:

1. A fixed caliper.
2. A floating caliper.
3. A sliding caliper.

The fixed caliper design uses two pistons mounted on either side of the rotor (in each side of the caliper). The caliper is mounted rigidly and does not move.

The sliding and floating designs are quite similar. In fact, these two types are often lumped together. In both designs, the pad on the inside of the rotor is moved into contact with the rotor by hydraulic force. The caliper, which is not held in a fixed position, moves slightly, bringing the outside pad into contact with the rotor. There are various methods of attaching floating calipers. Some pivot at the bottom or top, and some slide on mounting bolts. In any event, the end result is the same.

DRUM BRAKES

Drum brakes employ two brake shoes mounted on a stationary backing plate. These shoes are positioned inside a circular drum which rotates with the wheel assembly. The shoes are held in place by springs. This allows them to slide toward the drums (when they are applied) while keeping the linings and drums in alignment. The shoes are actuated by a wheel cylinder which is mounted at the top of the backing plate. When the brakes are applied, hydraulic pressure forces the wheel cylinder's actuating links outward. Since these links bear directly against the top of the brake shoes, the tops of the shoes are then forced against the inner side of the drum. This action forces the bottoms of the two shoes to contact the brake drum by rotating the entire assembly slightly (known as servo action). When pressure within the wheel cylinder is relaxed, return springs pull the shoes back away from the drum.

Most modern drum brakes are designed to self-adjust themselves during application when the vehicle is moving in reverse. This motion causes both shoes to rotate very slightly with the drum, rocking an adjusting lever, thereby causing rotation of the adjusting screw. Some drum brake systems are designed to self-adjust during application whenever the brakes are applied. This on-board adjustment system reduces the need for maintenance adjustments and keeps both the brake function and pedal feel satisfactory.

Adjustments

Periodic brake adjustment is not necessary as the front calipers are inherently self-adjusting, and the rear brakes are equipped with self-adjusters. In the event of a brake reline or component service requiring brake shoe removal, initial manual adjustment of the rear brake shoes will speed up servicing time. Front brake pads adjust themselves as the brake pedal is applied. After installing new front brake pads pump the brake pedal several times until a firm feeling is obtained. The pads will be incorrect adjustment.

DRUM BRAKES

The drum brakes are self-adjusting and require a manual adjustment only after the brake shoes have been replaced, or when the length of the adjusting screw has been changed while performing some other service operation, as i.e., taking off brake drums.

To adjust the brakes, follow the procedures given below:

Drum Installed

➧ See Figures 1 and 2

This procedure may only be performed on vehicles with a rubber access plug installed on the brake backing plate. For vehicles without this plug, please refer to the procedure for drum brakes that are removed.

1. Raise and safely support the rear end on jackstands.
2. Remove the rubber plug from the adjusting slot on the backing plate.
3. Insert a brake adjusting spoon into the slot and engage the lowest possible tooth on the starwheel. Move the end of the brake spoon downward to move the starwheel upward and expand the adjusting screw. Repeat this operation until the brakes lock the wheels.
4. Insert a small screwdriver or piece of firm wire (coat hanger wire) into the adjusting slot and push the automatic adjusting lever out and free of the starwheel on the adjusting screw and hold it there.
5. Engage the topmost tooth possible on the starwheel with the brake adjusting spoon. Move the end of the adjusting spoon upward to move the adjusting screw starwheel downward and contract the adjusting screw. Back off the adjusting screw starwheel until the wheel spins freely with a minimum of drag. Keep track of the number of turns that the starwheel is backed off, or the number of strokes taken with the brake adjusting spoon.
6. Repeat this operation for the other side. When backing off the brakes on the other side, the starwheel adjuster must be backed off the same number of turns to prevent side-to-side brake pull.
7. When the brakes are adjusted make several stops while backing the vehicle, to equalize the brakes at both of the wheels.
8. Remove the jackstands and lower the vehicle. Road test the vehicle.

Drum Removed

✱✱ CAUTION

Brake shoes may contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air! Avoid inhaling any dust from any brake surface! When cleaning brake surfaces, use a commercially available brake cleaning fluid.

1. Make sure that the shoe-to-contact pad areas are clean and properly lubricated.
2. Using and inside caliper check the inside diameter of the drum. Measure across the diameter of the assembled brake shoes, at their widest point.
3. Turn the adjusting screw so that the diameter of the shoes is 0.030 in. (0.8mm) less than the brake drum inner diameter.
4. Install the drum.

Brake Light Switch

REMOVAL & INSTALLATION

The switch is mounted on a bracket above the brake pedal and is contacted by the brake pedal arm.

1. If applicable, remove the knee bolster for access to the brake light switch and pedal.
2. Unplug the switch harness.
3. Press and hold the brake pedal, then while keeping the pedal depressed, then install the switch in the bracket.
4. Pull the switch rearward out of the mounting bracket and release the pedal.

ADJUSTMENT

Dakota Models

1. Push and hold the brake pedal in the applied position.
2. Push the switch forward until fully seated against the bracket.
3. Release the brake pedal.
4. Lightly pull the brake pedal rearward until the master cylinder pushrod bottoms against its internal stop. The switch plunger is now set at its proper clearance.

1989-93 Pick-Up and Ramcharger Models

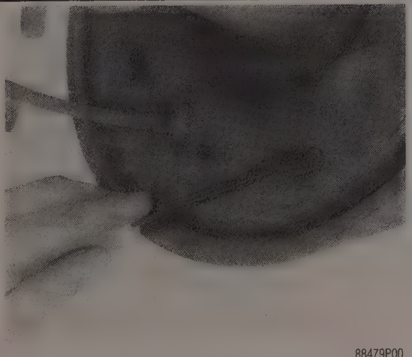
WITHOUT SPEED CONTROL

➧ See Figure 3

1. Loosen the switch-to-pedal bracket screw and slide the switch away from the pedal arm.
2. Push the pedal down by hand and allow it to return on its own to the free-hanging position. Do not pull it back!
3. Slide the switch towards the pedal until there is a gap of 0.140 in. (3.5mm) between the plunger and pedal arm.

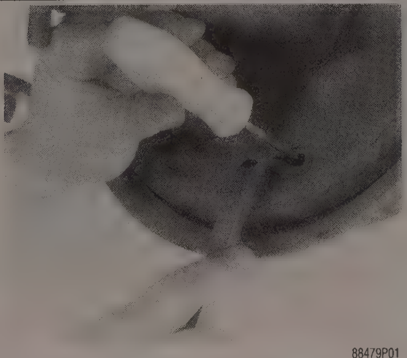
➡The pedal must not move when measuring the gap.

4. Tighten the switch screw to 82 inch lbs. (9 Nm). Recheck the gap.



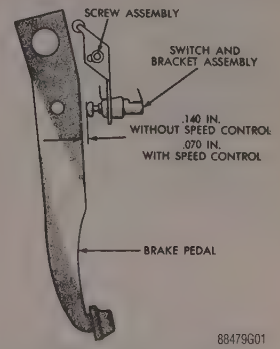
88479P00

Fig. 1 Use a prytool to remove the plug from the rear brake adjusting hole



88479P01

Fig. 2 Use a suitable tool to adjust the starwheel through the access hole


SCREW ASSEMBLY
SWITCH AND BRACKET ASSEMBLY
.140 IN. WITHOUT SPEED CONTROL
.070 IN. WITH SPEED CONTROL
BRAKE PEDAL

88479G01

Fig. 3 Brake light switch adjustment specifications—1989-93 models

WITH SPEED CONTROL

➧ **See Figure 3**

1. Push the switch through the clip in the mounting bracket until it is seated against the bracket. The pedal will move forward slightly.
2. Gently pull back on the pedal as far as it will go. The switch will ratchet backwards to the correct position.

1994-96 Pick-Up Models

This procedure calls for setting the switch prior to installation. Installation directions are included in this one procedure.

1. Preset the switch in the following manner:
   a. Pull the switch plunger all the way out until it is fully extended.
   b. Push the switch plunger inward 4 detent positions (clicks). This will provide the preset position for the switch installation. The plunger will extend approximately 0.55 in. (14mm) out of the housing at this setting.
2. Connect the harness wires to the switch.
3. Press and hold down the brake pedal.
4. Install the switch. Align the tab with the notch, then insert the switch and turn clockwise about 30° to lock it in place.

✻✻ WARNING

Do not use excessive force when setting the brake pedal switch or damage to the switch could result.

5. Release the brake pedal, then LIGHTLY pull the pedal fully rearward. The pedal will set the switch to the correct depth.

Master Cylinder

✻✻ WARNING

Clean, high quality brake fluid is essential to the safe and proper operation of the brake system. You should always buy the highest quality brake fluid that is available. If the brake fluid becomes contaminated, drain and flush the system, then refill the master cylinder with new fluid. Never reuse any brake fluid. Any brake fluid that is removed from the system should be discarded.

REMOVAL & INSTALLATION

Cast Iron Master Cylinder

➧ **See Figure 4**

➡Clean, high quality brake fluid is essential to the safe and proper operation of the brake system. You should always buy the highest quality brake fluid that is available. If the brake fluid becomes contaminated with dirt or water, drain and flush the system. Never reuse any brake fluid. Any brake fluid that is removed from the system should be discarded.

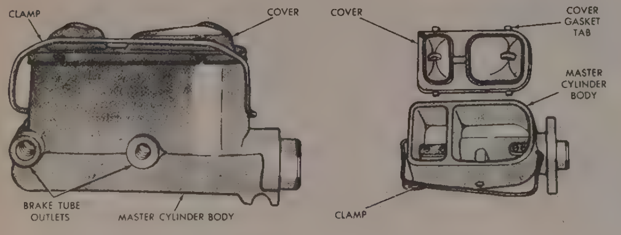


Fig. 4 A common cast iron master cylinder assembly

1. Disconnect the brake lines from the master cylinder.
2. Remove the bolt securing the pushrod to the pedal linkage.
3. Remove the master cylinder attaching nuts.
4. Slide the master cylinder from the truck.
5. Installation is the reverse of removal. Secure the mounting nuts to 16 ft. lbs. (22 Nm).
6. Bleed the master cylinder and brake system.

Aluminum Master Cylinder

➧ **See Figures 5, 6 and 7**

1. Disconnect the brake lines from the master cylinder.
2. Remove the master cylinder mounting nuts.
3. Slide the master cylinder out.
4. Installation is the reverse of removal. Secure the mounting nuts to 16 ft. lbs. (22 Nm).
5. Bleed the master cylinder and brake system.

Fig. 5 Disconnect the brake lines from the master cylinder outlet ports

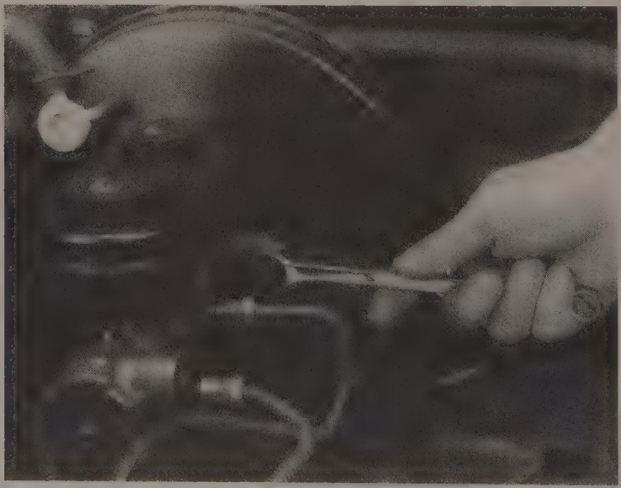


Fig. 6 With the lines free, unbolt the master cylinder from the brake booster

Fig. 7 Remove the disconnected master cylinder and set it in a clean location

Power Brake Booster

REMOVAL & INSTALLATION

➧ See Figure 8

1. Remove the master cylinder.
2. Disconnect the vacuum hose from the power booster.
3. Disconnect the pushrod from the brake pedal.
4. Remove the power booster attaching nuts and remove the booster.
5. Installation is the reverse of removal. Secure the booster mounting nuts to 16 ft. lbs. (22 Nm).

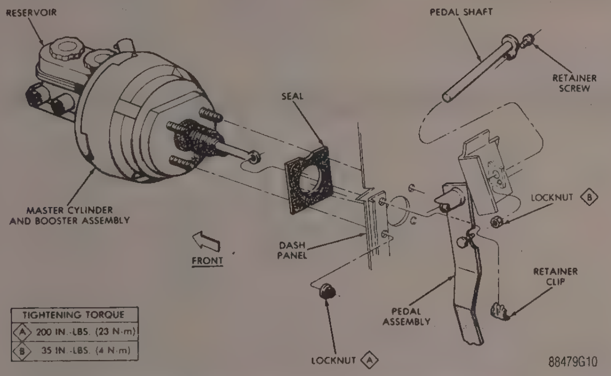

RESERVOIR
PEDAL SHAFT
RETAINER SCREW
SEAL
MASTER CYLINDER AND BOOSTER ASSEMBLY
LOCKNUT B
FRONT
DASH PANEL
RETAINER CLIP
PEDAL ASSEMBLY
TIGHTENING TORQUE
A 200 IN.-LBS. (23 N·m)
B 35 IN.-LBS. (4 N·m)
LOCKNUT A
88479G10

Fig. 8 Exploded view of the power brake booster assembly

Hydraulic Control Valves

➧ See Figures 9 and 10

➡All models incorporate the brake safety switch into either the metering valve or combination metering/proportioning valve.

REMOVAL & INSTALLATION

1. Raise and support the front end on jackstands.
2. Remove the splash shield.
3. Disconnect the wiring at the warning light switch.
4. Disconnect the brake lines at the valve.
5. Unbolt and remove the valve from the frame.

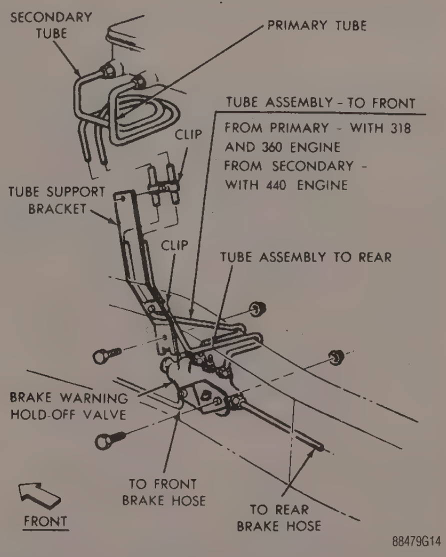

SECONDARY TUBE
PRIMARY TUBE
TUBE ASSEMBLY - TO FRONT
FROM PRIMARY - WITH 318 AND 360 ENGINE
FROM SECONDARY - WITH 440 ENGINE
CLIP
TUBE SUPPORT BRACKET
CLIP
TUBE ASSEMBLY TO REAR
BRAKE WARNING HOLD-OFF VALVE
TO FRONT BRAKE HOSE
FRONT
TO REAR BRAKE HOSE
88479G14

Fig. 9 Exploded view of the brake valve block—Pick-up and Ramcharger models

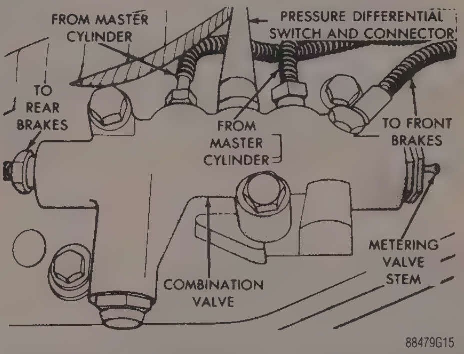

FROM MASTER CYLINDER
PRESSURE DIFFERENTIAL SWITCH AND CONNECTOR
TO REAR BRAKES
FROM MASTER CYLINDER
TO FRONT BRAKES
METERING VALVE STEM
COMBINATION VALVE
88479G15

Fig. 10 Brake fluid for Dakota models is routed through the combination valve's various outlets

6. Install the new valve and connect the lines and wiring. Bleed the brake system.

CENTERING THE PROPORTIONING VALVE

After the brake system has been opened for any reason the warning light will remain on until the proportioning valve is centralized. On all models, the valves are self-centering after the brakes are properly bled.

Bleeding the Brakes

When any part of the hydraulic system has been disconnected for repair or replacement, air may get into the lines and cause spongy pedal action (because air can be compressed and brake fluid cannot). To correct this condition, it is necessary to bleed the hydraulic system after it has been properly connected to be sure that all air is expelled from the brake cylinders and lines.

When bleeding the brake system, bleed one brake cylinder at a time, beginning at the cylinder with the longest hydraulic line (farthest from the master cylinder) first. keep the master cylinder reservoir filled with brake fluid during bleeding operation. Never use brake fluid that has been drained from the hydraulic system, no matter how clean it is.

It will not be necessary to centralize the pressure differential valve after a brake system failure has been corrected and the hydraulic system has been bled. The valve is self-centering.

There three methods for bleeding the air out of the brake system:

1. Gravity bleeding. Remove the master cylinder cover and gasket, then fill the reservoir with approved brake fluid. Open the bleeder screws and allow fluid

and air to drain until the stream of fluid is free of air bubbles. Use a liberal amount of oil absorbent material, shop towels or rags to soak up the brake fluid as it drains. Dispose of the mess properly. It does not make good garden mulch.

2. Pedal bleeding. This is the most widely-known service procedure requiring two people to perform. Have an assistant pump and hold the pedal to build up brake pressure, then open the bleeder valve until fluid squirts out. Remember not to stand directly in front of the valve when cracking it open. Be careful not to pump the master cylinder dry.

3. Pressure bleeding. This requires the use of pressure bleeding equipment not generally available to the general public at a price that makes it cost-effective to own. Leave this method to your professional mechanic. If you already have pressure bleeding equipment, we assume you know how to use it. If so, don't forget to lock the brake valve block stem open while pressure bleeding the system.

STANDARD BRAKE BLEEDING PROCEDURE

See Figures 11, 12 and 13

1. Clean all dirt from around the master cylinder fill cap, remove the cap and fill the master cylinder with brake fluid until the level is within ¼ in. (6mm) of the top of the edge of the reservoir.
2. Clean off the bleeder screws at the wheel cylinders and calipers.
3. Attach the length of rubber hose over the nozzle of the bleeder screw at the wheel to be done first. Place the other end of the hose in a glass jar, submerged in brake fluid.
4. Open the bleed screw valve ½-¾ turn.
5. Have an assistant slowly depress the brake pedal. Close the bleeder screw valve and tell your assistant to allow the brake pedal to return slowly. Continue this pumping action to force any air out of the system. When bubbles cease to appear at the end of the bleeder hose, close the bleed valve and remove the hose.
6. Check the master cylinder fluid level and add fluid accordingly. Do this after bleeding each wheel.
7. Repeat the bleeding operation at the remaining 3 wheels, ending with the one closest to the master cylinder. Fill the master cylinder reservoir.

MASTER CYLINDER BLEEDING

1. Fill the master cylinder reservoirs.
2. Place absorbent rags under the fluid lines at the master cylinder.
3. Have an assistant depress and hold the brake pedal.
4. With the pedal held down, slowly crack open the hydraulic line fitting, allowing the air to escape. Close the fitting and have the pedal released.
5. Repeat Steps 3 and 4 for each fitting until all the air is released.

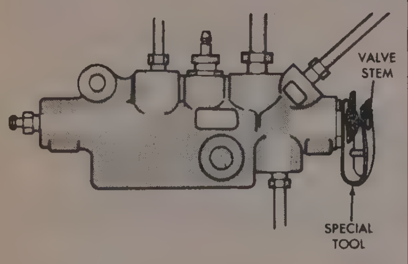


Fig. 11 If using a pressure bleeding system, extend the valve stem on the brake valve block

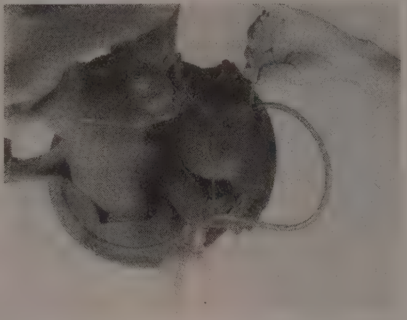


Fig. 12 Position a hanging plastic container and a hose connected to the bleeder valve (disc brake shown)

Fig. 13 While an assistant depresses the brake pedal, loosen the bleeder valve (drum brake shown)

FRONT DISC BRAKES

CAUTION

Brake pads may contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air! Avoid inhaling any dust from any brake surface! When cleaning brake surfaces, use a commercially available brake cleaning fluid.

Brake Pads

REMOVAL & INSTALLATION

WARNING

NEVER replace the pads on one side only! ALWAYS replace pads on both wheels as a set!

Dakota Models

See Figures 14 and 15

➡Dakota models use a single piston sliding caliper.

1. Raise and support the front end on jackstands.
2. Remove the wheels.
3. Press the caliper piston back into the bore with a suitable prytool. Use a large C-clamp to drive the piston into the bore of additional force is required.
4. Remove the caliper mounting bolts with a ⅜ in. hex wrench or socket.
5. Rotate the caliper rearward off the rotor and out from its mount.
6. Set the caliper on a crate or sturdy box, then remove the inboard and outboard brake pads. The inboard pad has a spring clip that holds it in the caliper. Tilt this pad out at the top to unseat the clip. The outboard pad has a retaining spring that secures it in the caliper. Unseat one spring end and rotate the pad out of the caliper.

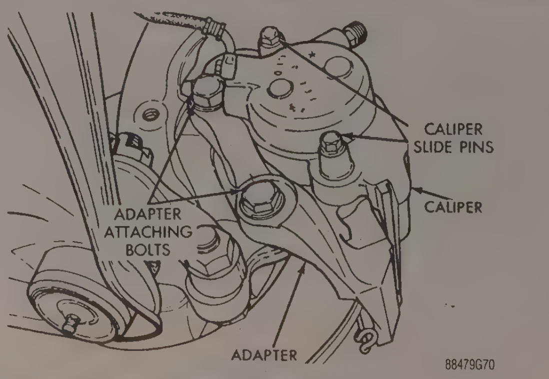


Fig. 14 Caliper mounting points—Dakota models

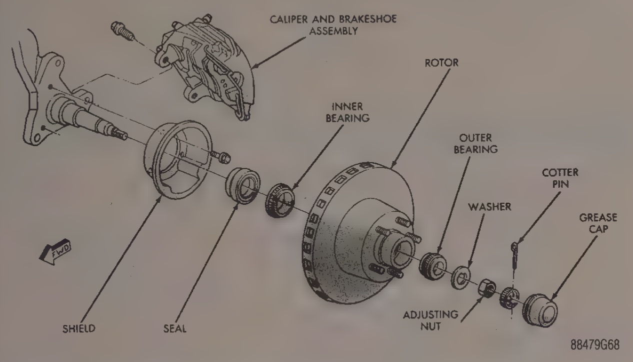

CALIPER AND BRAKESHOE ASSEMBLY
ROTOR
INNER BEARING
OUTER BEARING
COTTER PIN
WASHER
GREASE CAP
FWD
SHIELD
SEAL
ADJUSTING NUT
88479G68

Fig. 15 Exploded view of the Dakota disc brake components

✻✻ WARNING

DO NOT depress the brake pedal with the pads removed!

7. Secure the caliper to a chassis or suspension component with a sturdy wire. Do not let it hang from the hose.
8. Clean the caliper and steering knuckle sliding surfaces with a wire brush. Then, apply a coat of Mopar® multi-mileage grease, or equivalent.
9. Clean the caliper slide pins with brake cleaner or brake fluid. Then apply a light coating of silicone grease to the pins.

➡If there is minor rust or corrosion on the pins, first polish them with a crocus cloth. If they are severely rusted, replace them.

10. Installation is the reverse of removal. Secure the caliper mounting bolts by hand, then tighten them to 38 ft. lbs. (51 Nm). Final tighten the caliper slide pins to 18-26 ft. lbs. (25-35 Nm).
11. Install the wheels, lower the vehicle and pump the brakes several times to seat the pads.

Chrysler Sliding Caliper

➧ See Figures 16 thru 23

➡The 1989-93 D100/150, W100/150 and Ramcharger use the Chrysler sliding caliper with the 11.75 in. (298.5mm) rotor. The 1989-93 D200/250 and D300/350 and W200/250 with the Dana 44 axle use the Chrysler sliding caliper with a 12.82 in. (325.6mm) rotor.

1. Raise and support the front end on jackstands.
2. Remove the wheels.
3. Remove the caliper retaining clips and anti-rattle springs.
4. Remove the caliper from the disc by slowly sliding the caliper and brake pad assembly out and away from the disc. Do not damage the flexible brake hose.

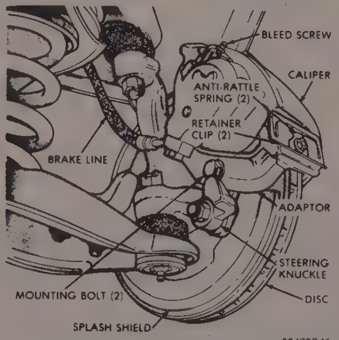

BLEED SCREW
CALIPER
ANTI-RATTLE SPRING (2)
RETAINER CLIP (2)
BRAKE LINE
ADAPTOR
STEERING KNUCKLE
DISC
MOUNTING BOLT (2)
SPLASH SHIELD
88479G41

Fig. 16 Rear view of the single piston Chrysler sliding caliper—2WD models

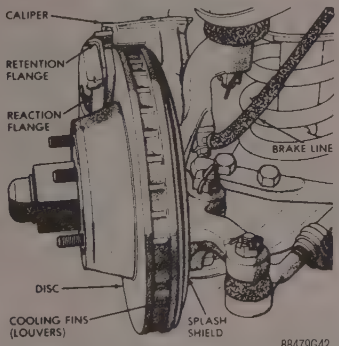

CALIPER
RETENTION FLANGE
REACTION FLANGE
BRAKE LINE
DISC
COOLING FINS (LOUVERS)
SPLASH SHIELD
88479G42

Fig. 17 Front view of the single piston Chrysler sliding caliper—2WD models

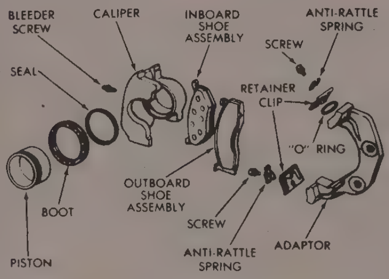

BLEEDER SCREW
CALIPER
INBOARD SHOE ASSEMBLY
ANTI-RATTLE SPRING
SCREW
SEAL
RETAINER CLIP
"O" RING
OUTBOARD SHOE ASSEMBLY
BOOT
SCREW
PISTON
ANTI-RATTLE SPRING
ADAPTOR
88479G47

Fig. 18 Exploded view of the Chrysler caliper and brake pad assembly

Fig. 19 Use a large C-clamp to press the caliper's piston back to its original position

Fig. 20 Loosen the anti-rattle spring from the caliper

Fig. 21 Set all hardware aside in order and in a safe location

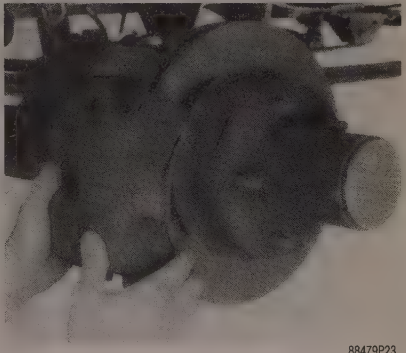


Fig. 22 Remove the caliper from its carrier

5. Drain some of the fluid from the master cylinder.

6. Remove the outboard pad from the caliper by prying between the pad and the caliper fingers. Remove the inboard pad from the caliper support by the same method. DO NOT depress the brake pedal with the pads removed!

To install:

7. Push the pistons to the bottom of their bores. This may be done with a large C-clamp or a pair of large pliers by placing a flat metal bar against the pistons and depressing the pistons with a steady force. This operation will displace some of the fluid in the master cylinder.

8. Slide the new pads into the caliper and caliper support. The ears of the pad should rest on the bridges of the caliper.

9. Install the caliper on the disc and install the caliper retaining clips, pins and anti-rattle springs. Pump the brake pedal until it is firm.

10. Check the fluid level in the master cylinder and add fluid as needed.

11. Install the wheels.

12. Road test the truck. The truck may pull to one side, but the pull should disappear shortly as the pads are seated.

Bendix Sliding Caliper Type

➧ See Figures 24, 25, 26, 27 and 28

➡This brake type is utilized by the W200/250 and W300/350 with the Dana or Spicer 60 axle. These models use a 12.88 in. (327mm) rotor with the caliper.

1. Remove and discard some of the fluid from the master cylinder without contaminating the contents to avoid overflow later on.

2. Support the front suspension on jackstands. Remove the wheels.

3. Put a large (at least 8 in./203mm) C-clamp over the caliper and use it to push the outer pad in and pull the caliper out. This bottoms the caliper piston in its bore.

4. Remove the key retaining screw. Drive the caliper support key and spring out toward the outside, using a brass drift.

5. Push the caliper down and rotate the upper end up and out. Support the caliper, so as not to damage the brake hose.

6. Remove the outer pad from the caliper. You may have to tap it to loosen it. Remove the inner pad, removing the anti-rattle clip from the lower end of the pad.

To install:

7. Thoroughly clean the sliding contact areas on the caliper and adaptor.

8. Put the new anti-rattle clip on the lower end of the new inner pad. Put the pad and clip in the pad abutment with the clip tab against the abutment and the loop-type spring away from the disc. Compress the clip and slide the upper end of the pad into place.

9. If the caliper piston isn't bottomed, press it in with a C-clamp.

10. The replacement outer pad may differ slightly from the original equipment. Put the outer pad in place and press the tabs into place with your fingers. You can press the tabs in with a C-clamp, but be careful of the lining.

11. Position the caliper on the adaptor by pivoting it around the upper mounting surface. Be careful of the boot.

12. Use a suitable prytool to hold the upper machined surface of the caliper against the support assembly. Drive a new key and spring assembly into place with a plastic mallet. Install the retaining screw and tighten to 12-20 ft. lbs. (16-27 Nm).

13. Replace the wheels and tires and lower the truck to the floor. Fill the master cylinder as specified in Section 1. Depress the brake pedal firmly several times to seat the pads on the disc. Don't drive until you get a firm pedal.

Delco Sliding Caliper

➧ See Figures 29 and 30

➡The 1994-96 Dakota and Pick-up models use the Delco sliding caliper.

1. Raise and support the front end on jackstands.

2. Remove the wheels.

3. Press the caliper piston back into the bore with a suitable prytool. Use a large C-clamp to drive the piston into the bore of additional force is required.

4. Remove the caliper mounting bolts with a ⅜ in. hex wrench or socket.

5. Rotate the caliper rearward off the rotor and out from its mount.

88479P24

Fig. 23 Inspect both pads for damage and wear

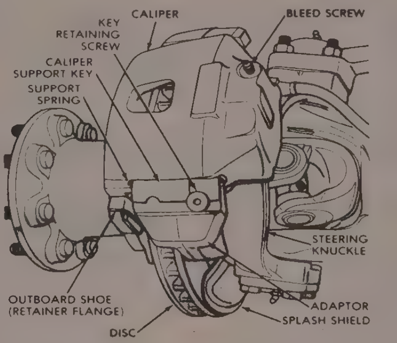

CALIPER
BLEED SCREW
KEY RETAINING SCREW
CALIPER SUPPORT KEY
SUPPORT SPRING
STEERING KNUCKLE
OUTBOARD SHOE (RETAINER FLANGE)
ADAPTOR
SPLASH SHIELD
DISC
88479G57

Fig. 24 Details of the Bendix brake assembly—1989-93 models

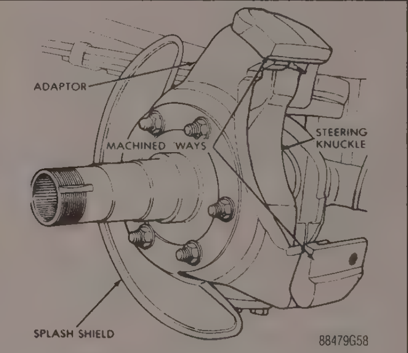

ADAPTOR
MACHINED WAYS
STEERING KNUCKLE
SPLASH SHIELD
88479G58

Fig. 25 Details of the Bendix caliper adapter and steering knuckle

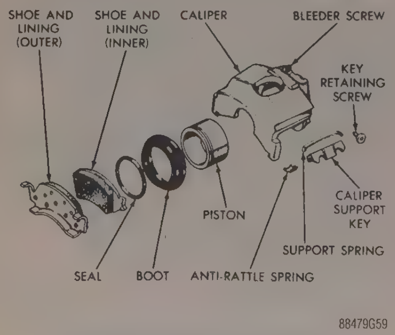

SHOE AND LINING (OUTER)
SHOE AND LINING (INNER)
CALIPER
BLEEDER SCREW
KEY RETAINING SCREW
CALIPER SUPPORT KEY
PISTON
SUPPORT SPRING
SEAL
BOOT
ANTI-RATTLE SPRING
88479G59

Fig. 26 Exploded view of the Bendix caliper and brake pad assembly

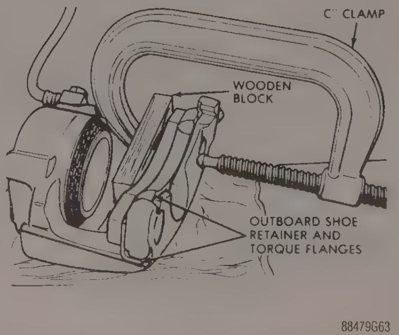

C CLAMP
WOODEN BLOCK
OUTBOARD SHOE RETAINER AND TORQUE FLANGES
88479G63

Fig. 27 Use a C-clamp to press out the outboard pad

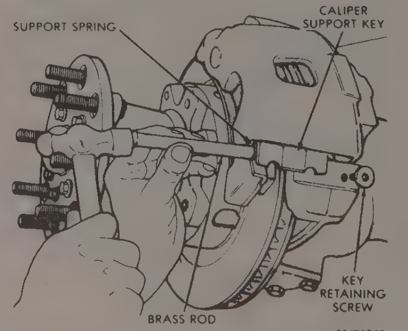

SUPPORT SPRING
CALIPER SUPPORT KEY
KEY RETAINING SCREW
BRASS ROD
88479G65

Fig. 28 Install the key and spring with a suitable hammer and brass rod

6. Set the caliper on a crate or sturdy box, then remove the inboard and outboard brake pads. The inboard pad has a spring clip that holds it in the caliper. Tilt this pad out at the top to unseat the clip. The outboard pad has a retaining spring that secures it in the caliper. Unseat one spring end and rotate the pad out of the caliper.

✱✱ WARNING

DO NOT depress the brake pedal with the pads removed!

7. Secure the caliper to a chassis or suspension component with a sturdy wire. Do not let it hang from the hose.

To install:

8. Clean the caliper and steering knuckle sliding surfaces with a wire brush. Then, apply a coat of Mopar® multi-mileage grease, or equivalent.

➥If there is minor rust or corrosion on the pins, first polish them with a crocus cloth. If they are severely rusted, replace them.

9. Lubricate the caliper mounting bolts, collars, bushings and bores with Dow 111®, or GE 661® silicone grease, or equivalent. (Please refer to illustrations).

10. Install the inboard pad and its spring clip then the outboard brake pad.

11. Install the caliper over the rotor and seat it flush in its original position. Next install the mounting bolts by hand, then tighten them to 38 ft. lbs. (51 Nm).

12. Install the wheels, lower the vehicle and pump the brakes several times to seat the pads.

INSPECTION

1989-93 Models

Remove the brake pads as described below and measure the thickness of the lining. If the lining at any point on the pad assembly is less than 1/16 in. (1.5mm) for light duty brakes or 1/32 in. (0.794mm) for heavy duty brakes, thick (above the backing plate or rivets), or there is evidence of the lining being contaminated by brake fluid or oil, replace the brake pad.

1994-96 Models

➧ See Figure 31

Inspect the condition of the outboard pad spring. Replace the spring if bent, distorted or broken.

Inspect the pads. If the lining is worn, cracked or burned, replace the pads. Also if the inboard retainer spring is damaged, replace the shoes.

Inspect the condition of the shoe tangs. The tang notches are important as they position the shoes in the adapter. The tangs also allow the shoes to slide on the adapter ledge for wear adjustment. Replace the shoes as a set is a tang on either shoe is bent, worn or damaged.

Brake Caliper

REMOVAL & INSTALLATION

Dakota Models

➧ See Figures 32, 33, 34 and 35

1. Raise and support the front end on jackstands.
2. Remove the wheels.
3. Disconnect the rubber brake hose from the tubing at the frame mount. If the pistons are to be removed from the caliper, leave the brake hose connected to the caliper. Check the rubber hose for cracks or chafed spots.
4. Plug the brake line to prevent loss of fluid.
5. Remove the caliper slide pins.
6. Remove the caliper and brake pads from the rotor adapter.
7. Installation is the reverse of removal. Align the caliper and start the pins in by hand. Tighten the pins to 22 ft. lbs. (30 Nm).

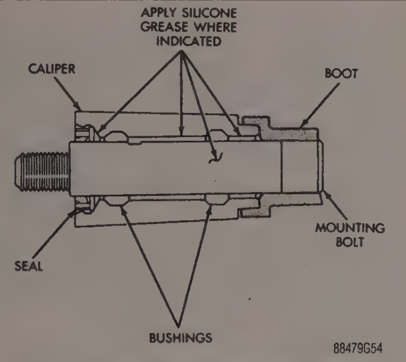

APPLY SILICONE GREASE WHERE INDICATED
CALIPER
BOOT
MOUNTING BOLT
SEAL
BUSHINGS
88479G54

Fig. 29 Mounting bolt lubrication points—1994-96 Pick-up light duty caliper

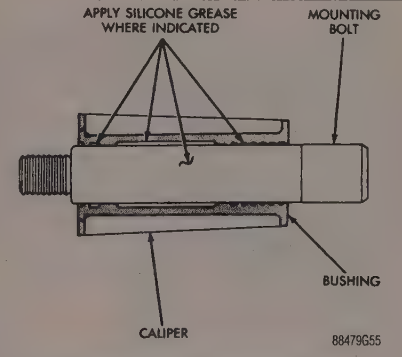

APPLY SILICONE GREASE WHERE INDICATED
MOUNTING BOLT
BUSHING
CALIPER
88479G55

Fig. 30 Mounting bolt lubrication points—1994-96 Pick-up heavy duty caliper

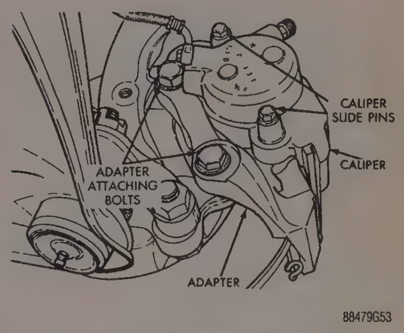

CALIPER SLIDE PINS
CALIPER
ADAPTER ATTACHING BOLTS
ADAPTER
88479G53

Fig. 31 Brake pad inspection points—Dakota pad shown

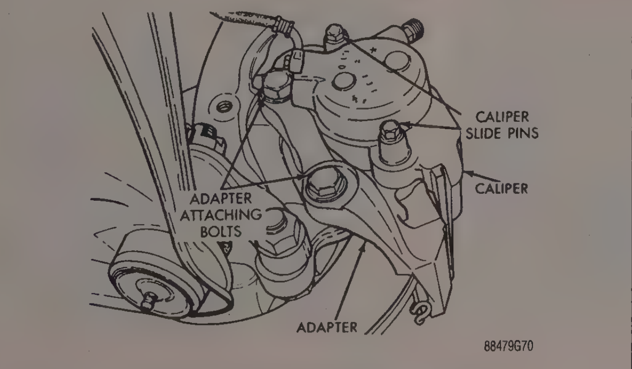

CALIPER SLIDE PINS
CALIPER
ADAPTER ATTACHING BOLTS
ADAPTER
88479G70

Fig. 32 Brake caliper mounting points—Dakota models

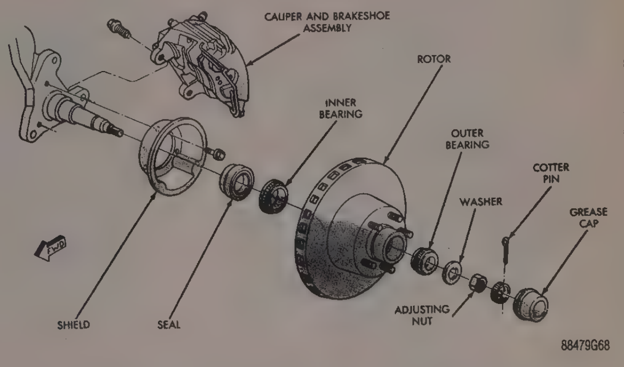

CALIPER AND BRAKESHOE ASSEMBLY
ROTOR
INNER BEARING
OUTER BEARING
COTTER PIN
WASHER
GREASE CAP
ADJUSTING NUT
SHIELD
SEAL
88479G68

Fig. 33 Exploded view of the Dakota disc brake components

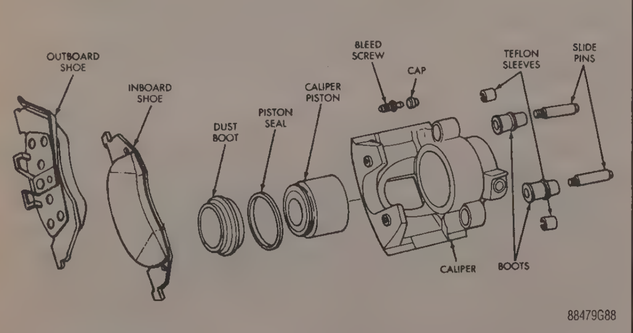

OUTBOARD SHOE
INBOARD SHOE
DUST BOOT
PISTON SEAL
CALIPER PISTON
BLEED SCREW
CAP
TEFLON SLEEVES
SLIDE PINS
CALIPER
BOOTS
88479G88

Fig. 34 Exploded view of the disc brake caliper components—2WD Dakota models

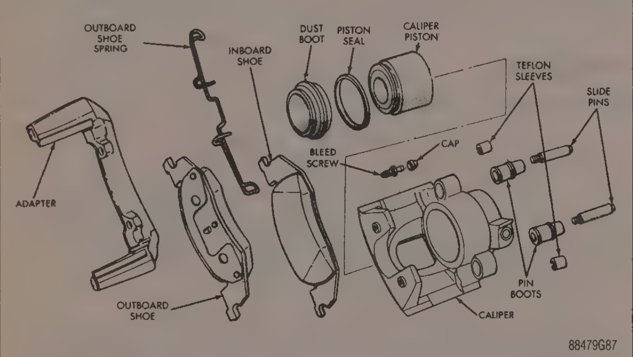

OUTBOARD SHOE SPRING
INBOARD SHOE
DUST BOOT
PISTON SEAL
CALIPER PISTON
TEFLON SLEEVES
SLIDE PINS
BLEED SCREW
CAP
ADAPTER
OUTBOARD SHOE
PIN BOOTS
CALIPER
88479G87

Fig. 35 Exploded view of the disc brake caliper components—4WD Dakota models

Chrysler Sliding Caliper

➧ See Figures 36 thru 41

1. Raise and support the front end on jackstands.
2. Remove the wheels.
3. Disconnect the rubber brake hose from the tubing at the frame mount. If the pistons are to be removed from the caliper, leave the brake hose connected to the caliper. Check the rubber hose for cracks or chafed spots.
4. Plug the brake line to prevent loss of fluid.
5. Remove the retaining screw, clip and anti-rattle spring that attach the caliper to the adaptor.
6. Carefully slide the caliper out and away from the disc. Check the pads to be sure that they are reinstalled in the same position.
7. Installation is the reverse of removal. Install the anti-rattle springs and retaining clips and tighten the retaining screws to 16 ft. lbs. (22 Nm).

➡The inboard shoe must always be installed on top of the retainer spring plate.

8. Fill the system with fresh fluid and bleed the brakes. Lower the vehicle.

Bendix Sliding Caliper

1. Support the front end on jackstands. Remove the wheel and tire.
2. Disconnect the brake hose. Cap the hose and plug the caliper.
3. Remove the key retaining screw and drive the key out with a brass drift.
4. Rotate the key end of the caliper out and slide the other end out.
5. Thoroughly clean the sliding areas.

To install:

6. Position the caliper rail into the slide on the support and rotate the caliper onto the rotor. Start the key and spring by hand. The spring should be between the key and caliper and the spring ends should overlap the key. If necessary, use a screwdriver to hold the caliper against the support assembly. Drive the key and spring into position, aligning the correct notch with the hole in the support. Install the key retaining screw and tighten to 12-20 ft. lbs. (16-27 Nm).

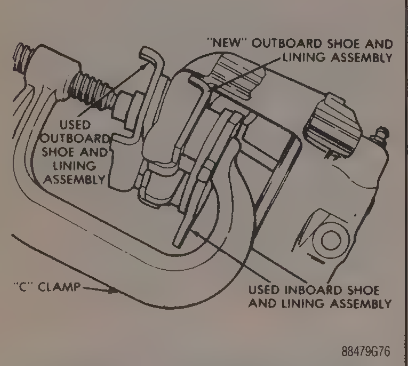

"NEW" OUTBOARD SHOE AND LINING ASSEMBLY
USED OUTBOARD SHOE AND LINING ASSEMBLY
"C" CLAMP
USED INBOARD SHOE AND LINING ASSEMBLY
88479G76

Fig. 36 Use a C-clamp to attach the shoe to the caliper fingers—Chrysler caliper

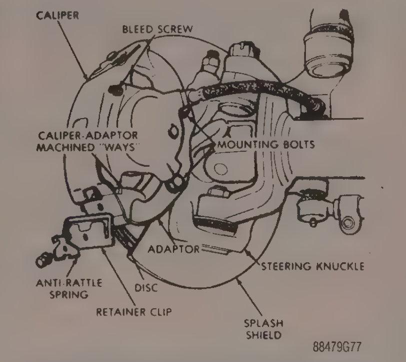

CALIPER
BLEED SCREW
CALIPER-ADAPTOR MACHINED "WAYS"
MOUNTING BOLTS
ADAPTOR
STEERING KNUCKLE
ANTI-RATTLE SPRING
DISC
RETAINER CLIP
SPLASH SHIELD
88479G77

Fig. 37 Rear view of the Chrysler sliding caliper assembly—4WD models shown

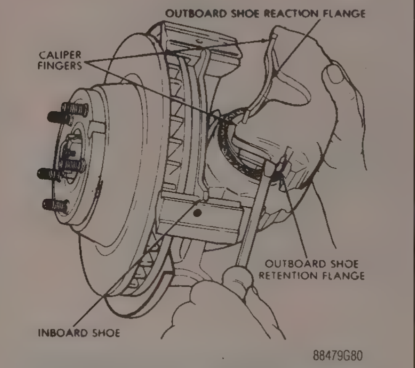

OUTBOARD SHOE REACTION FLANGE
CALIPER FINGERS
OUTBOARD SHOE RETENTION FLANGE
INBOARD SHOE
88479G80

Fig. 38 Pry the outboard shoe away from the Chrysler caliper fingers

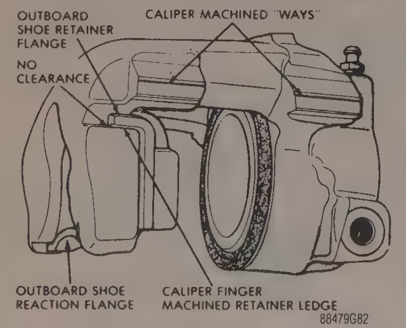

OUTBOARD SHOE RETAINER FLANGE
CALIPER MACHINED "WAYS"
NO CLEARANCE
OUTBOARD SHOE REACTION FLANGE
CALIPER FINGER MACHINED RETAINER LEDGE
88479G82

Fig. 39 View of the caliper flange and outboard shoe retainer flange—4WD models with Chrysler caliper

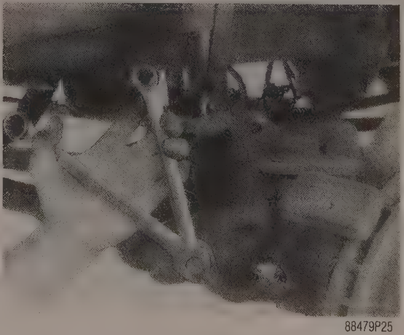


Fig. 40 Use two wrenches to disconnect the banjo bolt from the caliper brake line fittings

Fig. 41 Be sure to keep track of the hardware as you remove the caliper

7. Bleed the system of air. Replace the wheel and tire and lower the truck to the floor.

Delco Sliding Caliper

➡**The 1994-96 Dakota and Pick-up models use the Delco sliding caliper.**

1. Raise and support the front end on jackstands.
2. Remove the wheels.
3. Press the caliper piston back into the bore with a suitable prytool. Use a large C-clamp to drive the piston into the bore of additional force is required.
4. Remove the caliper mounting bolts with a ⅜ in. hex wrench or socket.
5. Loosen the bolt that secures the front brake hose fitting bolt in the caliper.
6. Rotate the caliper rearward off the rotor and out from its mount.
7. Remove the front brake hose fitting bolt completely, then remove the caliper with the pads installed as an assembly. Take care not to drip fluid onto the pad surfaces.

✲✲ WARNING

DO NOT depress the brake pedal with the caliper removed!

8. Cover the open end of the front brake hose fitting to prevent dirt entry.
9. Installation is the reverse of removal. Clean the caliper and steering knuckle sliding surfaces with a wire brush. Then, apply a coat of Mopar® multi-mileage grease, or equivalent.
10. Lubricate the caliper mounting bolts, collars, bushings and bores with Dow 111®, or GE 661® silicone grease, or equivalent. (Please refer to illustrations).
11. Install the mounting bolts by hand, then tighten them to 38 ft. lbs. (51 Nm).
12. Install the wheels, lower the vehicle and pump the brakes several times to seat the pads.

OVERHAUL

Chrysler Sliding Caliper

➧ See Figures 42 thru 47

1. Remove the caliper from the rotor.
2. If the pistons are to be removed, support the caliper on the upper control arm and surround it with towels to absorb the hydraulic fluid that will be lost.
3. Carefully depress the brake pedal to hydraulically push the piston from its bore. Prop the pedal at any position below the first 1 in. (25mm) of travel to prevent further loss of fluid.
4. Disconnect the plug and brake line after the first piston is removed.
5. Mount the caliper in a vise equipped with soft jaws.
6. Remove the dust boot.
7. Using a small wooden of plastic pointed tool, work the piston seal out of its groove in the piston bore.
8. Clean all parts in alcohol and allow to air dry.
9. Dip a new piston seal in the lubricant supplied with the factory rebuilding kit or in clean brake fluid. Install the seal in the groove in the bore.
10. Coat a new piston boot with lubricant and leave a generous amount inside the boot.
11. Install the piston seal into the caliper by working it into the groove with your fingers only. At first sight, the seal will appear larger than the bore, but will snap into place when properly seated.
12. Plug the high pressure inlet to the caliper and the bleeder screw hole and coat the piston with lubricant. Spread the boot with your fingers and work the piston into the boot, pressing down evenly.
13. Remove the plug and carefully push the piston down until it bottom.
14. Install the caliper on the vehicle, using the reverse order of removal.
15. Be sure to install the inboard pad anti-rattle spring on top of the retainer spring plate. Bleed the brakes. Road test the truck making several tops to wear any foreign material off of the pads.

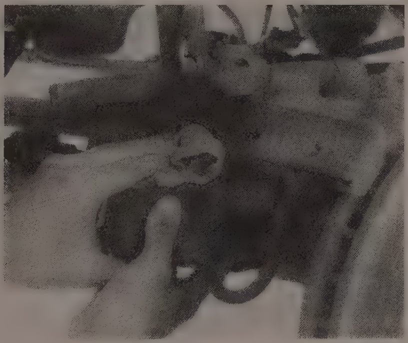


Fig. 42 Place shop towels over the piston to absorb brake fluid which is expelled

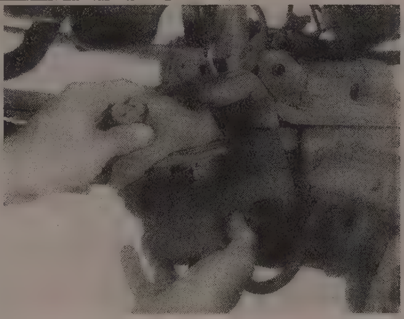


Fig. 43 As your assistant presses the brake pedal, the caliper piston will work its way out of the bore

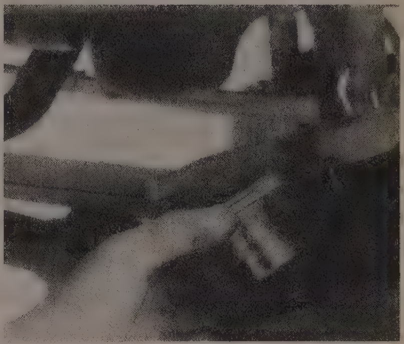


Fig. 44 Remove the piston for inspection and/or replacement

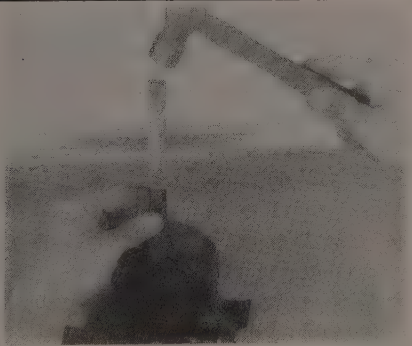


Fig. 45 Remove the outer seal from the caliper piston bore

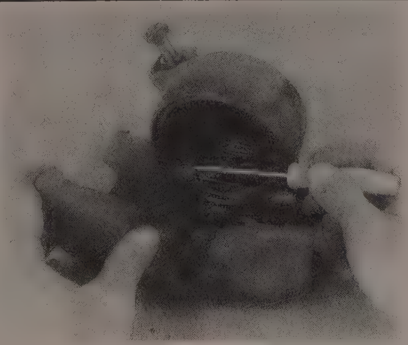


Fig. 46 Pry out the inner seal from the caliper piston bore

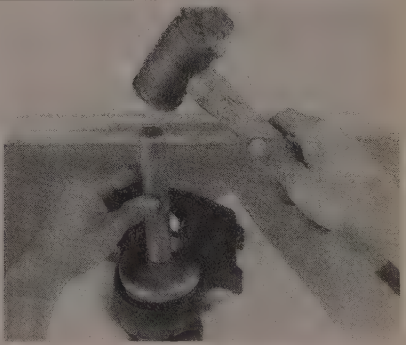


Fig. 47 Seat the seal using a suitable seal driver

Bendix Sliding Caliper

1. Clean the outside of the caliper in alcohol after removing it from the vehicle and removing the brake pads.
2. Drain the caliper through the inlet port.
3. Roll some thick shop cloths or rags and place them between the piston and the outer legs of the caliper.
4. Apply compressed air to the caliper inlet port until the piston comes out of the caliper bore. Use low air pressure to avoid having the piston pop out too rapidly and possible causing injury.
5. If the piston becomes cocked in the cylinder bore and will not come out, remove the air pressure and tap the piston with a soft hammer to try and straighten it. Do not use a sharp tool or pry the piston out of the bore. Reapply the air pressure.
6. Remove the boot from the piston and seal from the caliper cylinder bore.
7. Clean the piston and caliper in alcohol.
8. Lubricate the piston seal with clean brake fluid, and position the seal in the groove in the cylinder bore.
9. Coat the outside of the piston and both of the beads of dust boot with clean brake fluid. Insert the piston through the dust boot until the boot is around the bottom (closed end) of the piston.
10. Hold the piston and dust boot directly above the caliper cylinder bore, and use your fingers to work the bead of dust boot into the groove near the top of the cylinder bore.
11. After the bead is seated in the groove, press straight down on the piston until it bottoms in the bore. Be careful not to cock the piston in the bore. Be careful not to cock the piston in the bore. Use a large C-clamp with a block of wood inserted between the clamp and the piston to bottom the piston, if necessary.
12. Install the brake pads and install the caliper. Bleed the brake hydraulic system and recenter the pressure differential valve. Do not drive the vehicle until a firm brake pedal is obtained.

Delco Sliding Caliper

1. Drain the brake fluid from the caliper.
2. Remove the brake pads.
3. Use a one inch thick layer of shop towels to cushion the piston for removal from its bore.
4. Use several short bursts of low pressure air to remove the piston from the bore.
5. Use a suitable prytool to remove the dust boot, then discard the boot.
6. Remove all seals, mounting bolts and bushings. Discard the original seal. Replace other components as necessary.
7. Clean the outside of the caliper in alcohol after removing it from the vehicle and removing the brake pads.
8. Drain the caliper through the inlet port.
9. Inspect the condition of the piston bore. If necessary, use a fiber brush to clean it.
10. If necessary, use a crocus cloth to lightly clean the bore, but use no other abrasive material.
11. Inspect the piston carefully. It must be free of rust, corrosion and pits. If any of these wear signs are evident, replace the piston. Do not attempt to "clean up" the piston with an abrasive. This will only remove the special coating from the piston applied during manufacture.
12. Inspect the condition of the threads to the inlet and bleed screws. Repair damaged threads as necessary.
13. Check the bushings in the caliper bolt bores. replace if they are worn, cut or torn.
14. Make sure the work area is clean and dry.
15. Lubricate all components of the caliper with fresh brake fluid.
16. Install a new dust boot on the piston as follows:
    a. Lightly lubricate the lip of the new boot with Dow® or GE® silicone grease, or equivalent. Then work the boot lip into the boot groove at the top of the piston.
    b. Stretch the boot rearward to straighten the boot folds, then move the boot forward until it snaps into place.
17. Install a new seal on the piston. Slide the seal onto the piston and seat in the groove.
18. Install the piston. Apply more brake fluid to the piston, seal and bore. Then work the piston into the bore. Once the seal is properly seated, press the piston C\v of the way to the bottom of the bore by hand or with a hammer handle.
19. Seat the dust boot in the caliper with a suitable installer tool.
20. Finish pressing the piston to the bottom of the bore after the dust boot is seated.

Brake Disc (Rotor)

REMOVAL & INSTALLATION

1. Raise and safely support the front of the truck with jackstands. Remove the front wheel.
2. Remove the caliper assembly and support it to the frame with a piece of wire without disconnecting the brake fluid hose.
3. Remove the hub and rotor assembly.
4. Install the rotor in the reverse order of removal, and adjust the wheel bearing as outlined in Section 1.

INSPECTION

➧ See Figures 48, 49, 50 and 51

If the rotor is deeply scarred or has shallow cracks, it may be refinished on a disc brake rotor lathe. Also, if the lateral run-out exceeds 0.010 in. (0.25mm) within a 6 in. (152mm) radius when measured with a dial indicator, with the stylus 1 in. (25mm) in from the edge of the rotor, the rotor should be refinished or replaced.

A maximum of 0.020 in. (0.5mm) of material may be removed equally from each friction surface of the rotor. If the damage cannot be corrected when the rotor has been machined to the minimum thickness shown on the rotor, it should be replaced.

The finished braking surfaces of the rotor must be parallel within 0.007 in. (0.178mm) and lateral run-out must not be more than 0.003 in. (0.076mm) on the inboard surface in a 5 in. (127mm) radius.

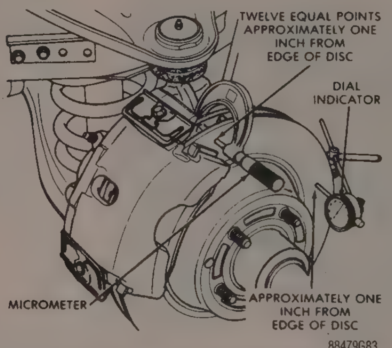

TWELVE EQUAL POINTS APPROXIMATELY ONE INCH FROM EDGE OF DISC
DIAL INDICATOR
MICROMETER
APPROXIMATELY ONE INCH FROM EDGE OF DISC
88479G83

Fig. 48 Use a dial indicator and micrometer to check the rotor for run-out and thickness

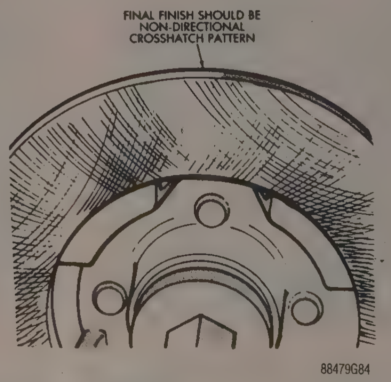


Fig. 49 A correct final rotor finish

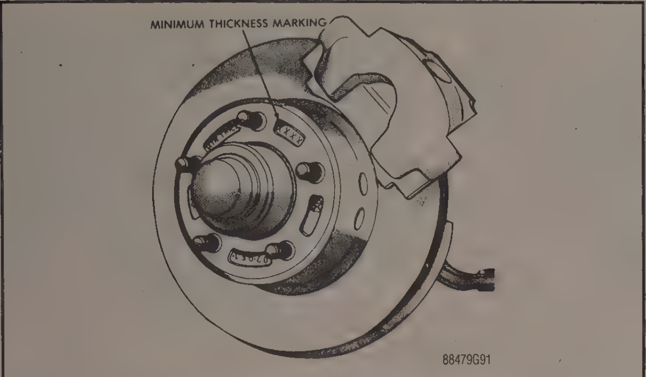

MINIMUM THICKNESS MARKING
88479G91

Fig. 50 Location of the rotor minimum thickness marking

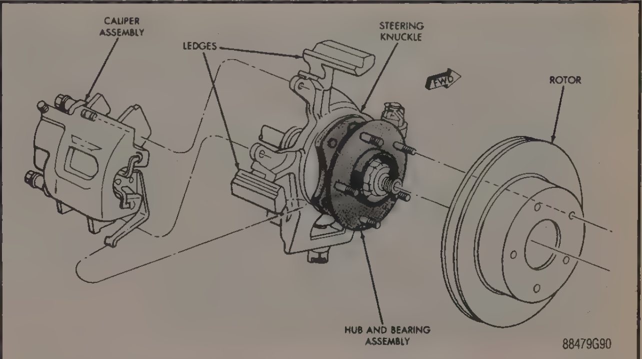

CALIPER ASSEMBLY
LEDGES
STEERING KNUCKLE
FWD
ROTOR
HUB AND BEARING ASSEMBLY
88479G90

Fig. 51 Exploded view of a rotor mounting to the hub—4WD Dakota models shown

REAR DRUM BRAKES

CAUTION

Brake shoes may contain asbestos, which has been determined to be a cancer causing agent. Never clean the brake surfaces with compressed air! Avoid inhaling any dust from any brake surface! When cleaning brake surfaces, use a commercially available brake cleaning fluid.

Brake Drum

INSPECTION

➧ See Figures 52 and 53

Check that there are no cracks or chips in the braking surface. Excessive bluing indicates overheating and a replacement drum is needed. The drum can be machined to remove minor damage and to establish a rounded braking surface on a warped drum. Never exceed the maximum oversize of the drum when machining the braking surface. The maximum inside diameter is stamped on the rim of the drum.

REMOVAL & INSTALLATION

Chrysler Servo Type with Single Anchor

➧ See Figures 54 and 55

1. Raise and safely support the truck.
2. Remove the plug from the brake adjustment access hole.
3. Insert a thin bladed screwdriver through the adjusting hole and hold the adjusting lever away from the starwheel.
4. Release the brake by prying down against the starwheel with a brake spoon.
5. Remove the rear wheel and clips from the wheel studs. Remove the brake drum.
6. Installation is the reverse of removal. Adjust the brakes.

Bendix Duo-Servo Type

➧ See Figure 56

1. Raise and safely support the vehicle.
2. Remove the rear wheel and tire.
3. Remove the axle shaft nuts, washers and cones. If the cones do not readily release, rap the axle shaft sharply in the center.
4. Remove the axle shaft.
5. Remove the outer hub nut.
6. Straighten the lockwasher tab and remove it along with the inner nut and bearing.
7. Carefully remove the drum.
8. Installation is the reverse of removal. Position the drum on the axle housing.
9. Install the bearing and inner nut. While rotating the wheel and tire, tighten the adjusting nut until a slight drag is felt. Back off the adjusting nut ⅙ turn so that the wheel rotates freely without excessive end-play. Road test the vehicle.

Brake Shoes

REMOVAL & INSTALLATION

Servo Type With Single Anchor

➧ See Figures 57 thru 66

1. Raise and support the vehicle.

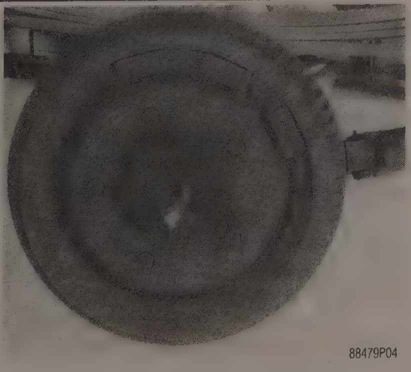


Fig. 52 A common rear drum assembly

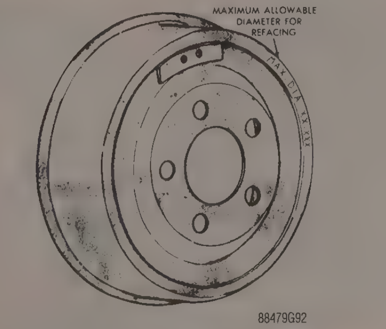

MAXIMUM ALLOWABLE DIAMETER FOR REFACING
MAX DIA XX XXX
88479G92

Fig. 53 Look for the maximum inside diameter specification stamped on the drum

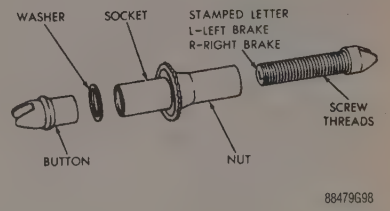

WASHER
SOCKET
STAMPED LETTER
L-LEFT BRAKE
R-RIGHT BRAKE
SCREW THREADS
BUTTON
NUT
88479G98

Fig. 54 Exploded view of the brake adjusting screw or "starwheel" assembly

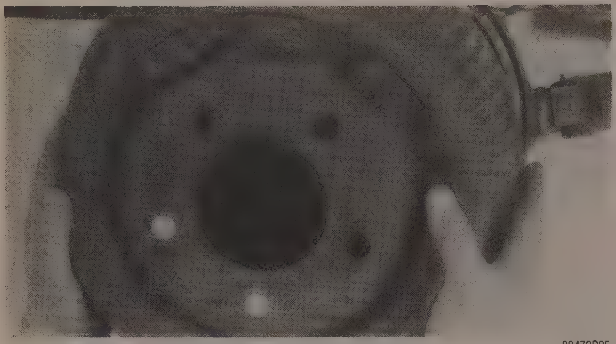


Fig. 55 When the shoe tension is released, remove the drum from the brake assembly

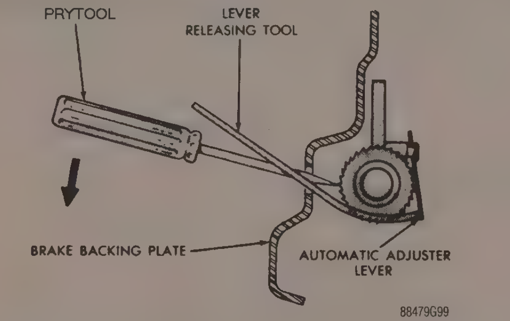

PRYTOOL
LEVER RELEASING TOOL
BRAKE BACKING PLATE
AUTOMATIC ADJUSTER LEVER
88479G99

Fig. 56 Use a lever releasing tool to depress the adjuster lever while turning the starwheel with a prytool—Bendix brakes

2. Remove the rear wheel, drum retaining clips and the brake drum.
3. Remove the brake shoe return springs, noting how the secondary spring overlaps the primary spring.
4. Remove the brake shoe retainer, springs and nails.
5. Disconnect the automatic adjuster cable from the anchor and unhook it from the lever. Remove the cable, cable guide, and anchor plate.
6. Remove the spring and lever from the shoe web.
7. Spread the anchor ends of the primary and secondary shoes and remove the parking brake spring and strut.
8. Disconnect the parking brake cable and remove the brake assembly.
9. Remove the primary and secondary brake shoe assemblies and the star adjuster as an assembly. Block the wheel cylinders to retain the pistons.

To install:

10. Measure the drum as described in this section.
11. Apply a thin coat of lubricant to the support platforms.
12. Attach the parking brake lever to the back side of the secondary shoe.
13. Place the primary and secondary shoes in their relative positions on a workbench.
14. Lubricate the adjuster screw threads. Install it between the primary and secondary shoes with the star wheel next to the secondary shoe. The star wheels are stamped with an L (left) and R (right).
15. Overlap the ends of the primary and second brake shoes and install the adjusting spring and lever at the anchor end.
16. Hold the shoes in position and install the parking brake cable into the lever.
17. Install the parking brake strut and spring between the parking brake lever and primary shoe.
18. Place the brake shoes on the support and install the retainer nails and springs.
19. Install the anchor pin plate. Attach the eye of the adjusting cable over the anchor pin and install the return spring between the anchor pin and primary shoe.

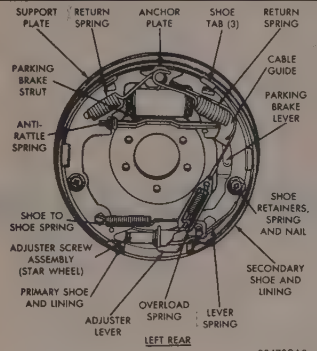

SUPPORT PLATE
RETURN SPRING
ANCHOR PLATE
SHOE TAB (3)
RETURN SPRING
CABLE GUIDE
PARKING BRAKE STRUT
PARKING BRAKE LEVER
ANTI-RATTLE SPRING
SHOE RETAINERS, SPRING AND NAIL
SHOE TO SHOE SPRING
ADJUSTER SCREW ASSEMBLY (STAR WHEEL)
SECONDARY SHOE AND LINING
PRIMARY SHOE AND LINING
OVERLOAD SPRING
LEVER SPRING
ADJUSTER LEVER
LEFT REAR
88479GA6

Fig. 57 Details of a common single anchor type brake assembly

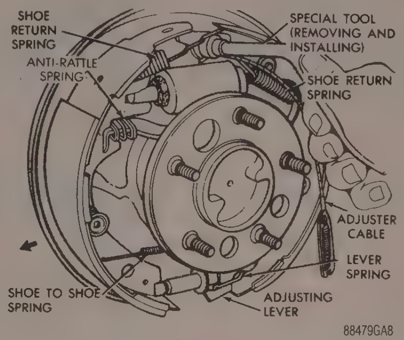

SHOE RETURN SPRING
ANTI-RATTLE SPRING
SPECIAL TOOL (REMOVING AND INSTALLING)
SHOE RETURN SPRING
ADJUSTER CABLE
LEVER SPRING
SHOE TO SHOE SPRING
ADJUSTING LEVER
88479GA8

Fig. 58 Use a suitable removal/installation tool to service the shoe return springs

Fig. 59 Use a quick-drying brake spray cleaner to remove some of the grime from the brake components

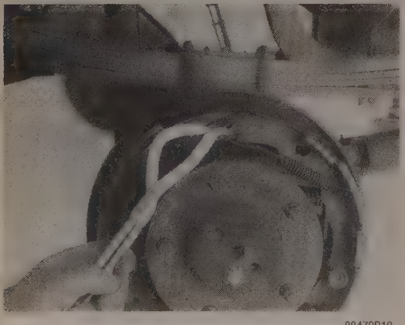


Fig. 60 A special brake spring tool makes removing/installing the return springs much simpler

Fig. 61 Disconnect the cable from the rear brake assembly

Fig. 62 Using a special tool, push in and turn to remove the spring-loaded shoe retaining pins

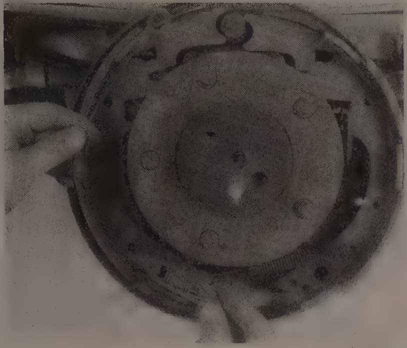


Fig. 63 Remove the adjuster cable from the Chrysler rear brake assembly

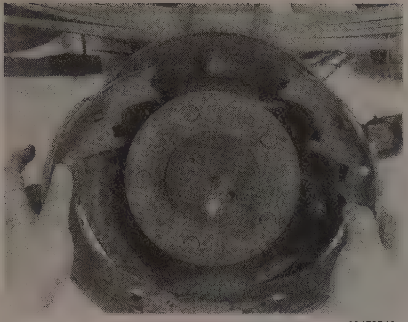


Fig. 64 Remove the shoe assemblies from their mounts once the retaining pins are removed

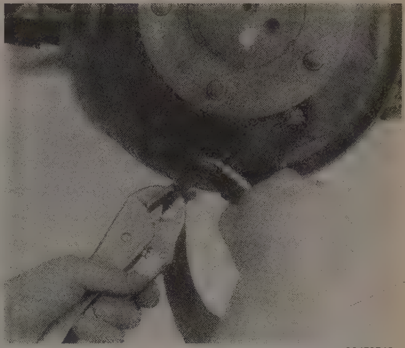


Fig. 65 Remove the parking brake cable end from the lever arm

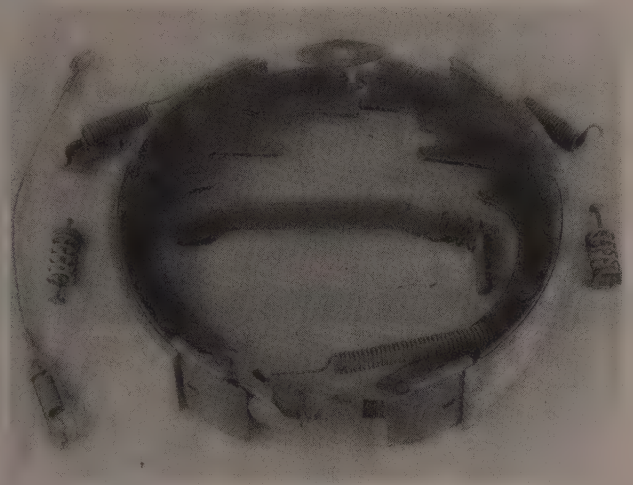


Fig. 66 Components (arranged in order) of the Chrysler rear brake assembly

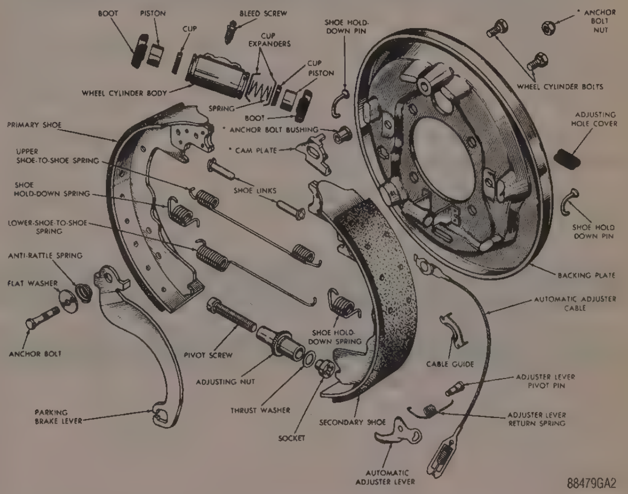

BOOT
PISTON
CUP
BLEED SCREW
CUP EXPANDERS
SHOE HOLD-DOWN PIN
* ANCHOR BOLT NUT
CUP
PISTON
WHEEL CYLINDER BOLTS
WHEEL CYLINDER BODY
SPRING
BOOT
* ANCHOR BOLT BUSHING
ADJUSTING HOLE COVER
PRIMARY SHOE
* CAM PLATE
UPPER SHOE-TO-SHOE SPRING
SHOE LINKS
SHOE HOLD-DOWN SPRING
LOWER-SHOE-TO-SHOE SPRING
SHOE HOLD DOWN PIN
ANTI-RATTLE SPRING
BACKING PLATE
FLAT WASHER
AUTOMATIC ADJUSTER CABLE
SHOE HOLD-DOWN SPRING
ANCHOR BOLT
PIVOT SCREW
CABLE GUIDE
ADJUSTING NUT
ADJUSTER LEVER PIVOT PIN
THRUST WASHER
PARKING BRAKE LEVER
SECONDARY SHOE
ADJUSTER LEVER RETURN SPRING
SOCKET
AUTOMATIC ADJUSTER LEVER
88479GA2

Fig. 67 Exploded view of the Bendix rear brake components

20. Install the cable guide in the secondary shoe and install the secondary return spring. Be sure that the primary spring overlaps the secondary spring.
21. Position the adjusting cable in the groove of the cable guide and engage the hook of the cable in the adjusting lever.
22. Install the brake drum and retaining clips. Install the wheel and tire.
23. Adjust the brakes and road test the truck.

Bendix Duo-Servo type

▶ See Figure 67

1. Unhook and remove the adjusting lever return spring.
2. Remove the lever from the lever pivot pin.
3. Unhook the adjuster lever from the adjuster cable.
4. Unhook the upper shoe-to-shoe spring.
5. Unhook and remove the shoe hold-down springs.
6. Disconnect the parking brake cable from the parking brake lever.
7. Remove the shoes with the lower shoe-to-shoe spring and star wheel as an assembly.

To install the shoes:

8. The pivot screw and adjusting nut on the left side have left-hand threads and right hand threads on the right side.
9. Lubricate and assemble the star wheel assembly. Lubricate the guide pads on the support plates.
10. Assemble the star wheel, lower shoe-to-shoe spring, and the primary and secondary shoes. Position this assembly on the support plate. The remainder of installation is the reverse of removal.
11. Install the brake drum and adjust the brakes.

Wheel Cylinder

REMOVAL & INSTALLATION

▶ See Figures 68, 69 and 70

When the brake drums are removed, carry out an inspection of the wheel cylinder boots for cuts, tears, cracks, or leaks. If any of these are present, the wheel cylinder should be replaced.

Fig. 68 Loosen the wheel cylinder retaining bolts from behind the brake backing plate

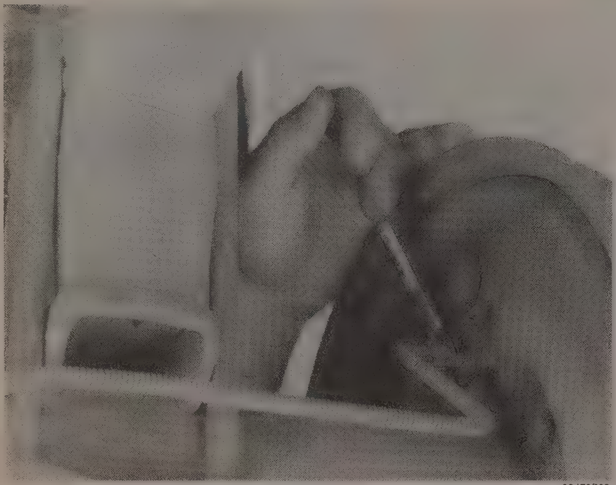


Fig. 69 Use a wrench of the correct size to loosen the brake line fitting from the wheel cylinder

➡**Preservative fluid is used during assembly; its presence in small quantities does not indicate a leak.**

1. Remove the brake shoes and check them. Replace them if they are soaked with grease or brake fluid.

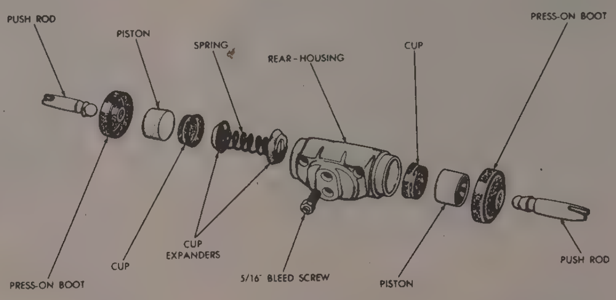

PUSH ROD
PISTON
SPRING
REAR-HOUSING
CUP
PRESS-ON BOOT
CUP EXPANDERS
CUP
PRESS-ON BOOT
5/16" BLEED SCREW
PISTON
PUSH ROD
88479GA5

Fig. 70 Exploded view of a common wheel cylinder assembly

2. Detach the brake hose.
3. Unfasten the wheel cylinder attachment bolts and slide the wheel cylinder off its support.
4. Installation is the reverse of removal. Tighten all components securely.

PARKING BRAKE

Cables

REMOVAL & INSTALLATION

➧ **See Figure 71**

Front Cable

1. Raise and support the rear end on jackstands.
2. Remove the adjusting nut at the equalizer.
3. Disengage the cable housing at the lower anchor point and remove the cable and housing from the bracket.
4. Remove the cable housing anchor clip at the parking brake lever.
5. Remove the anchor clip from the lever.
6. Remove the housing grommet from the floor board.
7. Installation is the reverse of removal. Adjust the brakes.

Intermediate Cable

1. Remove the adjusting nut at the cable tensioner.
2. Disengage the rear end of the cable from the ratio lever and remove the cable.
3. Installation is the reverse of removal. Adjust the brakes.

Rear Cable

1. Raise and support the rear end on jackstands.
2. Remove the rear wheels.
3. Remove the drums.
4. Remove the brake shoe return springs.
5. Remove the brake shoe retaining springs.
6. Remove the shoes, strut and spring from the support plate.
7. Disconnect the cable from the operating arm.
8. Compress the retainers on the end of the cable housing and remove the cable from the support plate.
9. Move the retaining clip out at the crossmember.
10. Disconnect the brake cable from the equalizer.
11. Installation is the reverse of removal. Adjust the brakes.

ADJUSTMENT

➧ **See Figure 71**

1. Adjust the service brakes by making a few stops in reverse.
2. Raise and support the rear end on jackstands.
3. Release the parking brake lever and loosen the cable adjusting nut to be sure that the cable is slack.
4. Tighten the cable adjusting nut until a slight drag is felt while rotating the wheels.
5. Loosen the cable adjusting nut until the wheels can be rotated freely, then back off the cable adjusting nut two turns.
6. Apply the parking brake several times, then release it and check to be sure that the rear wheels rotate freely.

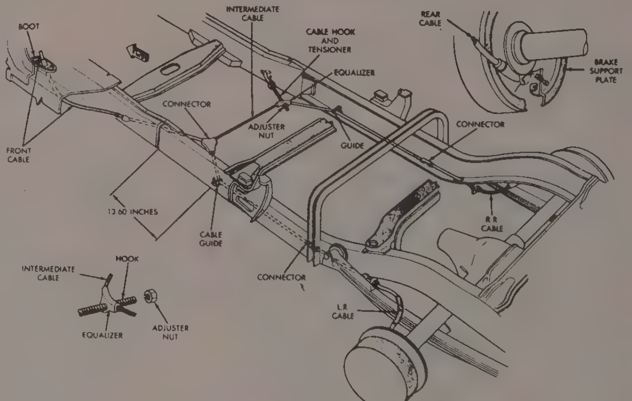

INTERMEDIATE CABLE
BOOT
CABLE HOOK AND TENSIONER
REAR CABLE
EQUALIZER
BRAKE SUPPORT PLATE
CONNECTOR
ADJUSTER NUT
GUIDE
CONNECTOR
FRONT CABLE
13.60 INCHES
CABLE GUIDE
R.R CABLE
HOOK
INTERMEDIATE CABLE
CONNECTOR
L.R CABLE
EQUALIZER
ADJUSTER NUT
88479GB8

Fig. 71 Typical parking brake cable layout

REAR WHEEL ANTI-LOCK (RWAL) BRAKE SYSTEM

General Information

➧ See Figures 72, 73 and 74

The purpose of the Rear Wheel Anti-Lock (RWAL) brake system is to prevent rear wheel lock-up under heavy braking conditions on all types of road surfaces. The RWAL system uses a standard master cylinder and booster arrangement with a vertical hydraulic circuit. An electronic control module, rear wheel speed sensor and a dual-solenoid hydraulic control valve are the major components of the system.

There are some minor changes in the brake lines, hoses and electrical circuits to accommodate the RWAL system on models so equipped. No hydraulic pumps are used; brake pressure comes directly from the pedal application.

The system provides stability by allowing at least one rear wheel to remain unlocked. It's still possible to lock the front wheels, since this system works on the rear wheel only. The benefits of RWAL are also somewhat limited when the vehicle is in the 4WD mode (where applicable).

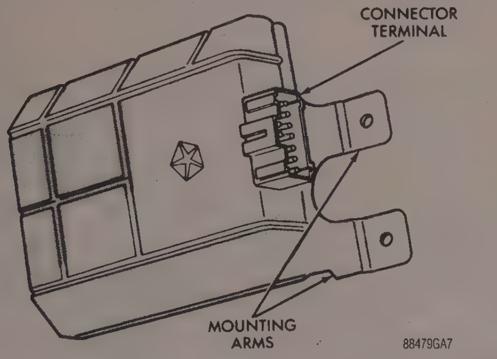


Fig. 72 A common RWAL control module

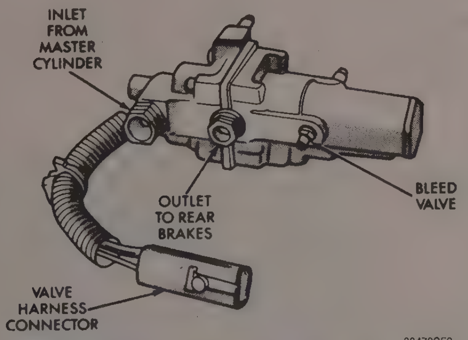


Fig. 73 A common hydraulic control valve assembly—RWAL brake system

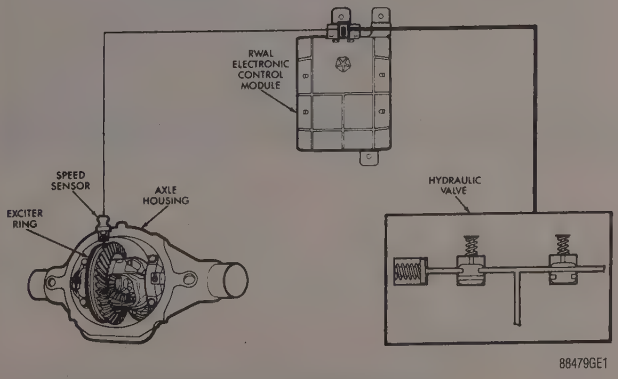


Fig. 74 Major components of the RWAL system

An amber anti-lock warning light is provided on the instrument panel to supplement the red brake warning light. Looking for this amber light is the simplest way of determining whether or not the vehicle is equipped with RWAL.

A speed sensor is mounted to the top of the rear differential housing. A toothed exciter ring is press-fitted onto the differential case next to the differential ring gear. The exciter ring provides the signal for the sensor which, in turn, sends the signal to the control module.

The electric control module is located on the lower right side of the cowl panel. The control module monitors the rear wheel speed and controls the dual solenoid valve. The module also performs a system self-check every time the ignition switch is turned from the **OFF** to the **ON** position.

The dual-solenoid hydraulic valve allows brake fluid to flow freely between the master cylinder and the rear brakes under normal operating conditions. Once anti-lock braking begins, the control module triggers the valve to either isolate or reduce pressure to the rear wheel.

FAULT CODES

➧ See Figure 75

If a system fault is detected during the self-test, or at any other time, the control module will illuminate the anti-lock indicator lamp and store the fault code in the microprocessor memory. If a fault code is generated, the module will remember the code after the ignition is switched **OFF**. The microprocessor will store in memory and display only one fault code at a time. The stored code can be displayed by grounding the RWAL diagnostic connector and counting the number of flashes on the indicator lamp. To clear a fault code, disconnect the control module or disconnect the battery for at least 5 seconds. During the system retest, wait at least 30 seconds to make sure the fault code does not reappear.

FAULT CODE NUMBER	TYPICAL FAILURE DETECTED
1	Not used.
2	Open isolation valve wiring or bad control module.
3	Open dump valve wiring or bad control module.
4	Closed RWAL valve switch.
5	Over 16 dump pulses generated in 2WD vehicles (disabled for 4WD).
6	Erratic speed sensor reading while rolling.
7	Electronic control module fuse pellet open, isolation output missing, or valve wiring shorted to ground.
8	Dump output missing or valve wiring shorted to ground.
9	Speed sensor wiring/resistance (usually high reading).
10	Sensor wiring/resistance (usually low reading).
11	Brake switch always on. RWAL light comes on when speed exceeds 40 mph.
12	Not used.
13	Electronic control module phase lock loop failure.
14	Electronic control module program check failure.
15	Electronic control module RAM failure.

88479GA9

Fig. 75 RWAL system fault codes

RWAL Control Module

REMOVAL & INSTALLATION

See Figures 76, 77 and 78

1. Remove the passenger side sill plate and cowl cover.
2. Remove the screws attaching the control module to the cowl side.
3. Make sure the ignition is **OFF**, then disconnect the control module connector and remove the control module from the vehicle.
4. Installation is the reverse of removal.

RWAL Speed Sensor

REMOVAL & INSTALLATION

See Figure 79

1. Raise the vehicle and support it safely.
2. Remove the sensor hold-down bolt.
3. Remove the sensor shield and sensor from the differential by pulling the sensor straight out.
4. Disconnect the wiring and remove the sensor.
5. Installation is the reverse of removal. Secure the sensor hold-down bolt to 14-19 ft. lbs. (19-26 Nm).

Dual Solenoid Hydraulic Valve

REMOVAL & INSTALLATION

See Figure 80

1. Raise the vehicle and support it safely.
2. Remove the brake lines from the dual solenoid hydraulic valve.
3. Remove the two nuts attaching the valve to the frame rail.
4. Remove the valve from the frame and disconnect the wiring.
5. Installation is the reverse of removal. Secure the valve on the frame and tighten the mounting bolts to 16-25 ft. lbs. (21-34 Nm).
6. Bleed the brake system as previously described.

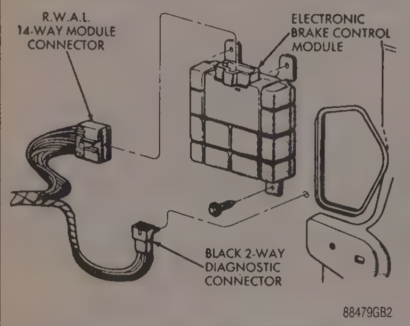

R.W.A.L. 14-WAY MODULE CONNECTOR
ELECTRONIC BRAKE CONTROL MODULE
BLACK 2-WAY DIAGNOSTIC CONNECTOR
88479GB2

Fig. 76 Exploded view of the RWAL electronic control module wiring connectors—Dakota models

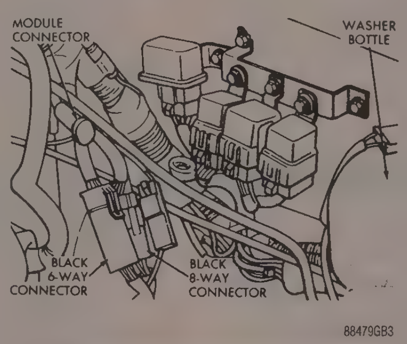

MODULE CONNECTOR
WASHER BOTTLE
BLACK 6-WAY CONNECTOR
BLACK 8-WAY CONNECTOR
88479GB3

Fig. 77 RWAL underhood connector locations—Dakota models

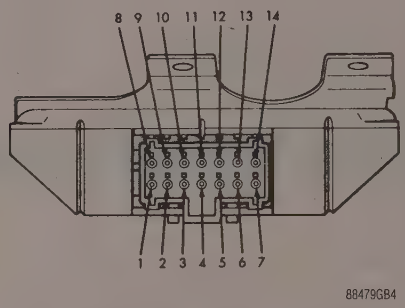

8
9
10
11
12
13
14
1
2
3
4
5
6
7
88479GB4

Fig. 78 RWAL control module connector pin numbers

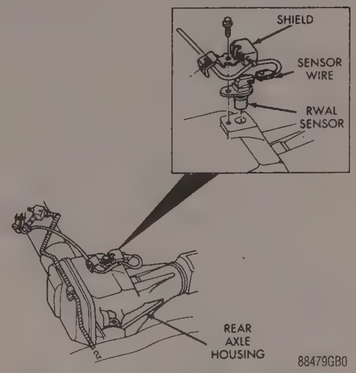

SHIELD
SENSOR WIRE
RWAL SENSOR
REAR AXLE HOUSING
88479GB0

Fig. 79 Details of the RWAL speed sensor mounting

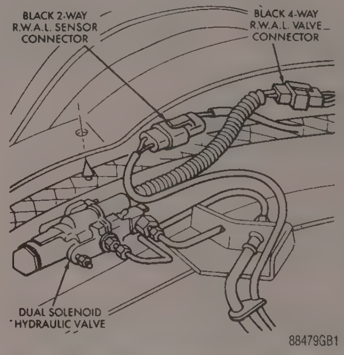

BLACK 2-WAY R.W.A.L. SENSOR CONNECTOR
BLACK 4-WAY R.W.A.L. VALVE CONNECTOR
DUAL SOLENOID HYDRAULIC VALVE
88479GB1

Fig. 80 Location of the dual solenoid hydraulic valve and related wiring connectors

ALL-WHEEL ANTI-LOCK BRAKE SYSTEM (ABS)

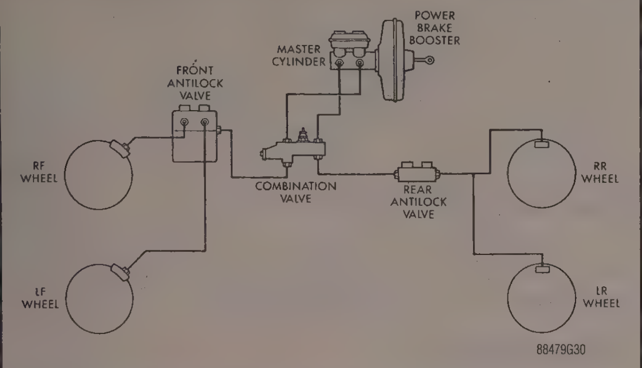
Description and Operation

See Figures 81, 82 and 83

Found on 1993-96 Dakotas and Pick-ups, the all-wheel Anti-lock Brake System (ABS) is a unique combined system. It consists of the Rear Wheel Anti-Lock (RWAL) system components, plus the additional parts needed to create an all-wheel ABS system. For the 1996 model year, the names for some of the components were changed; however, the system remains essentially the same as in the 1993-95 model years.

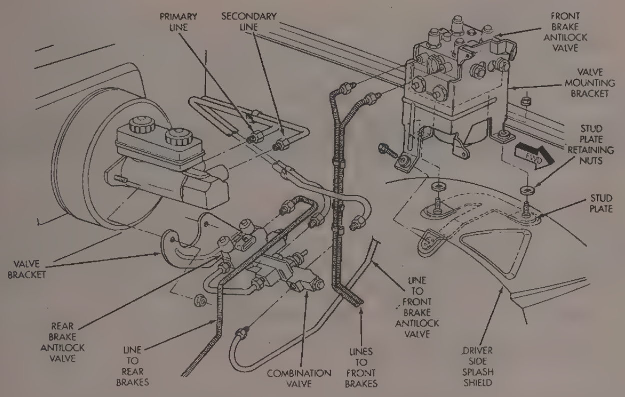
The ABS system will prevent wheel locking under heavy braking. By preventing wheel lock-up, maximum braking effort is maintained while preventing loss of directional control. Additionally, some steering capability is maintained during the stop. The ABS system will operate regardless of road surface conditions.

There are conditions for which the ABS system provides no benefit. Hydroplaning is possible when the tires ride on a film of water, losing contact with the paved surface. This renders the vehicle totally uncontrollable until road contact is regained. Extreme steering maneuvers at high speed or cornering beyond the limits of tire adhesion can result in skidding which is independent of vehicle braking. For this reason, the system is named anti-lock rather than anti-skid.



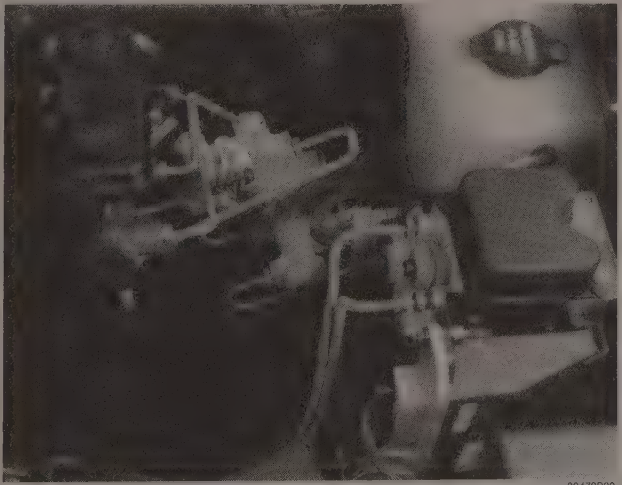
88479G30

Fig. 81 ABS hydraulic system schematic—1993-96 models


PRIMARY LINE
SECONDARY LINE
FRONT BRAKE ANTILOCK VALVE
VALVE MOUNTING BRACKET
STUD PLATE RETAINING NUTS
STUD PLATE
VALVE BRACKET
LINE TO FRONT BRAKE ANTILOCK VALVE
REAR BRAKE ANTILOCK VALVE
LINE TO REAR BRAKES
COMBINATION VALVE
LINES TO FRONT BRAKES
DRIVER SIDE SPLASH SHIELD

88479G37

Fig. 82 Major ABS components—Dakota models shown; Pick-ups are similar



88479P33

Fig. 83 Specialized components convert the Dodge RWAL brake system to an all-wheel ABS system

Under normal braking conditions, the ABS system functions in the same manner as a standard brake system. The primary difference is that power assist is gained from hydraulic pressure rather than a conventional vacuum booster.

The ABS system is a three-channel design. The front brake anti-lock valve provides two-channel pressure control of the front brakes. Each front wheel brake unit is controlled separately. Two solenoid valves are used in each control channel.

The rear anti-lock valve controls the rear wheel brakes as a pair. The rear brake valve contains two solenoid valves.

The front and rear anti-lock valves contain electrically operated solenoid valves. The solenoid valves modulate brake fluid to apply pressure during anti-lock braking. The valves are operated by the anti-lock electronic module.

The electrical system for the ABS system is separate and independent from the other electrical circuits in the vehicle. A specially programmed electronic control module is used to operate the system components.

The pump/motor assembly on the front anti-lock valve provides the fluid volume needed during anti-lock braking. The pump is operated by an integral electric motor. The DC type motor is controlled by the ABS module.

The ABS Module (called Controller Anti-lock Brake/CAB in 1996) is the electronic brain of the system, receiving and interpreting speed signals from the four sensors at the wheels. The ABS module will enter anti-lock mode when it senses impending wheel lock at any wheel and immediately controls the line pressure(s) to the affected wheel(s). The hydraulic assembly serves as both an integral master cylinder and the hydraulic booster assembly for the brake system. It contains the wheel circuit valves used to control the brake fluid pressure to each wheel circuit.

During anti-lock braking, line pressures are controlled or modulated by the rapid cycling of electronic valves within the hydraulic assembly. These valves can allow pressures within the system to increase, remain constant or decrease, depending on the needs of the moment as registered by the ABS module. The front wheels are controlled individually, while the rear wheels receive the same electrical signal, based on the wheel with the greatest locking tendency. Anti-lock function is available above 3-5 mph (4.5-8 km/h).

The operator may hear a popping or clicking sound as the pump and/or control valves cycle on and off during normal operation. The sounds are due to normal operation and are not indicative of a system problem; under most conditions, the sounds are only faintly audible. If ABS is engaged, the operator may notice some pulsation in the pedal. If additional force is applied to the pedal during an ABS-engaged stop, the operator will notice extremely hard pedal feel. This is due to isolation of the master cylinder during ABS operation. Some pulsing may also be felt in the body of the vehicle due to suspension movement as brake pressures apply and release at the individual wheels.

The ABS system is equipped with built-in diagnostic capability. At every start-up, the ABS module illuminates the dashboard warning lights and turns them off after checking the circuitry. When the vehicle reaches a certain preset speed, the ABS module conducts a system check, briefly activating all the control valves to confirm their operation. This system check may be noticed by the operator as a series of rapid clicks during initial drive-off; the sound is normal and not indicative of a problem. Some fault conditions will cause the ABS module to set and retain a trouble code which may be retrieved for diagnostic purposes. Stored fault codes will remain stored until cleared by the DRB II, or equivalent scan tool.

The ABS module will illuminate the appropriate dashboard warning lamp according to the fault detected. It is possible to have a fault affecting only the ABS function; in this case, the ABS system will be disabled, but the vehicle will retain normal braking capability.

SERVICE PRECAUTIONS

- Certain components within the ABS system are not intended to be serviced or repaired individually. Only those components with removal and installation procedures should be serviced.
- Do not use rubber hoses or other parts not specifically specified for the ABS system. When using repair kits, replace all parts included in the kit. Partial or incorrect repair may lead to functional problems and require the replacement of components.
- Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air to clean parts; damage to rubber components may result.
- Use only DOT 3 brake fluid from an unopened container.
- If any hydraulic component or line is removed or replaced, it may be necessary to bleed the entire system.
- A clean repair area is essential. Always clean the reservoir and cap thoroughly before removing the cap. The slightest amount of dirt in the fluid may plug an orifice and impair the system function. Perform repairs after components have been thoroughly cleaned; use only denatured alcohol to clean com-

ponents. Do not allow ABS components to come into contact with any substance containing mineral oil; this includes used shop rags.

- The ABS module (called Controller Anti-lock Brakes/CAB in 1996) is a microprocessor similar to other computer units in the vehicle. Insure that the ignition switch is **OFF** before removing or installing controller harnesses. Avoid static electricity discharge at or near the controller.
- Always wear safety goggles when disconnecting lines and fittings.

DIAGNOSTIC PROCEDURE

➧ See Figure 84

ABS system diagnosis involves checking only those components that form the anti-lock system. Diagnosis of the ABS system consists of 3 general steps, performed in order. The first indicator that something is amiss in the ABS system is the illumination of the warning light display. Second, a visual or preliminary inspection is always required before any other steps are taken. Third, the problem should be identified.

In most cases, identification of a problem can ONLY be performed using the DRB II scan tool, or equivalent. The scan tool must be hooked up to the ABS diagnostic connector which is clipped to the underside of the knee bolster, just below the steering column.

The ABS diagnostic connector is a six-way type and is either light blue or black in color. The connector is the ABS access point for the DRB (or equivalent) scan tool. System components can be tested after the tool is attached.

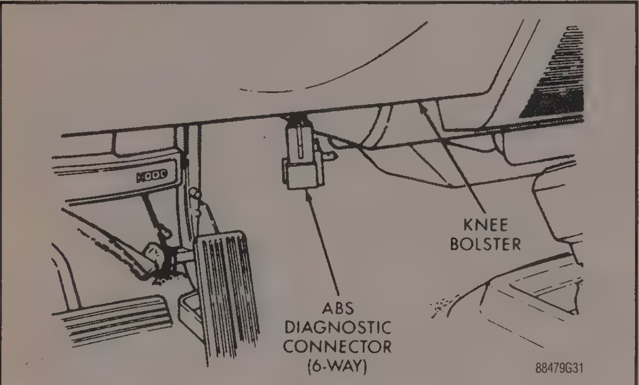


Fig. 84 Location of the ABS diagnostic connector

Visual Inspection

Although specific diagnosis requires special diagnostic tools, a careful visual inspection may turn up a simple problem that can be remedied without the need to spend time and effort in having the vehicle looked at by a professional shop.

Before diagnosing an apparent ABS problem, make absolutely certain that the normal braking system is in correct working order. Many common brake problems (dragging lining, seepage, etc.) will affect the ABS system. A visual check of specific system components may reveal problems creating an apparent ABS malfunction.

1. Inspect the brake fluid level in the reservoir.
2. Inspect brake lines, hoses, master cylinder assembly, brake calipers and cylinders for leakage.
3. Visually check brake lines and hoses for excessive wear, heat damage, punctures, contact with other parts, missing clips or holders, blockage or crimping.
4. Check the calipers and wheel cylinders for rust or corrosion. Check for proper sliding action if applicable.
5. Check the caliper and wheel cylinder pistons for freedom of motion during application and release.
6. Inspect the wheel speed sensors for proper mounting and connections.
7. Inspect the tone wheels for broken teeth or poor mounting.
8. Inspect the wheels and tires on the vehicle. They must be of the same size and type to generate accurate speed signals. Check also for approximately equal tire pressures.
9. Confirm the fault occurrence with the operator. Certain driver induced faults, such as not releasing the parking brake fully, will set a fault code and trigger the dash warning light(s). Excessive wheel spin on low-traction surfaces, high speed acceleration or riding the brake pedal may also set fault codes and trigger a warning lamp. These induced faults are not system failures but examples of vehicle performance outside the parameters of the ABS module.
10. The most common cause of intermittent faults is not a failed sensor but a loose, corroded or dirty connector. Incorrect installation of the wheel speed sensor will cause a loss of wheel speed signal. Check harness and component connectors carefully.

Diagnostic Mode

Connect the DRB II scan tool, or equivalent tester, according to instructions furnished with the tool. The system will enter diagnostic mode and prompt the operator through the assorted system checks and tests.

Dashboard Warning Lamp

BRAKE WARNING LAMP

The red BRAKE warning lamp will be illuminated to warn the operator of conditions which may result in reduced braking ability. These conditions include:

- Parking brake not fully released.
- Low brake fluid.
- Hydraulic assembly or ABS module

The lamp will also illuminate whenever the ignition switch is put in the **START** position or the ignition switch is turned to **ON**. Under these bulb test conditions, the lamp should stay illuminated for about 2 seconds.

✻✻ CAUTION

Illumination of the BRAKE lamp indicates a condition affecting the braking ability of the vehicle. The vehicle should not be driven until the seriousness of the problem is determined. In most cases, conditions illuminating the BRAKE lamp will also illuminate the ANTI-LOCK warning lamp, disabling that system as well.

ANTI-LOCK WARNING LAMP

The amber anti-lock light illuminates at start-up as part of the system self-check feature. The light will remain lit two or three seconds, then go off as part of its normal routine.

The amber ANTI-LOCK warning lamp is controlled by the ABS module. If the controller detects a condition resulting in the shut-down of the ABS function, the ANTI-LOCK lamp will be lit. The ANTI-LOCK lamp is normally lit until the ABS module completes its self-tests; if no faults are found, the lamp is turned off.

Display of the ANTI-LOCK warning lamp by itself indicates only that the ABS function has been disabled. Power-assisted normal braking is still available and the vehicle may be driven with reasonable care.

A system fault, such as the loss of speed sensor signal, or solenoid failure, will cause the amber warning light to come on. The most effective procedure here is to check for obvious damage first. Beyond this, the system will have to be checked with a DRB II scan tool, or equivalent tester.

ABS Control Module

➡On 1996 models, this component was renamed the Controller Antilock Brakes (CAB).

TESTING

The electronic module controls all phases of anti-lock system operation. The module also differentiates between normal and anti-lock model braking.

The module monitors and processes signals generated by the system sensors at all times.

The module operating program includes a self-check routine that test each of the system components. A failure of the self-check program will cause illumination of the amber warning light. The light will also illuminate if a solenoid or other system component fails during the dynamic phase of initialization.

If a system malfunction should occur, do not immediately assume the control module is the problem. A blown system fuse, bad ground, or loss of feed voltage will cause system faults similar to a module failure.

➥Do not replace the module unless the scan tool verifies the module is actually at fault.

Beyond the general tests of the ABS system components listed in this section, all specific tests of this component require the use of the DRB II, or equivalent, scan tool.

REMOVAL & INSTALLATION

Pick-Ups

1. Disconnect the negative battery cable.
2. Release the controller connector locking handle and remove the connector.
3. Remove the 2 controller mounting bolts and remove the controller from the bracket.
4. Installation is the reverse of removal.

Dakotas

➧ See Figure 85

1. Disconnect the negative battery cable.
2. Disconnect the upper control harness connector from the module.
3. Lift the connector locking handle to release the main harness connector from the module. Rotate the handle upward to clear the connector.
4. Lift the connector up and out of the retaining lugs on the module.
5. Remove the screws attaching the module to the mounting bracket, then remove the module.
6. Installation is the reverse of removal. Secure all components accordingly.

Front Wheel Anti-Lock (ABS) Valve

➥On 1996 models, this component was renamed the Hydraulic Control Unit (HCU). The HCU consists of the front anti-lock valve assembly and a pump/motor unit.

The ABS valve/control module is located in the engine compartment at the driver's inner fender panel. The control unit is attached to the forward side of the Hydraulic Control Unit mounting bracket.

REMOVAL & INSTALLATION

Pick-Ups

➧ See Figures 86 and 87

1. If necessary, remove the battery for improved access.
2. Disconnect the electrical harness at the ABS valve.
3. Unlatch and disconnect the harness at the ABS module.
4. Disconnect the two front brake lines at the ABS valve.
5. Remove the stud nuts and bolt that attach the ABS valve to the inner fender panel. Then, remove the valve from the engine compartment.
6. If the valve is only being removed for access to another component, cover the brake line fluid ports with tape or plugs to keep dirt out.
7. Remove the bolts attaching the module to the valve, then remove the module.
8. Installation is the reverse of removal. Secure the ABS valve on the mounting studs and tighten the mounting bolt and stud nuts to 92-112 inch lbs. (10-13 Nm).
9. Fill and bleed the brake system according to the proper procedure.

Dakota Models

1. Disconnect the negative battery cable.
2. Disconnect the brake lines at the front wheel anti-lock valve.
3. Disconnect the harness wires at the front anti-lock valve.
4. Remove the screw and nuts attaching the front anti-lock valve to the stud plate.
5. Lift the valve upward off the studs and remove the valve and bracket as an assembly.
6. Installation is the reverse of removal. Secure the front anti-lock valve stud nuts to 92-112 inch lbs. (10-13 Nm) and the screws to 170-220 inch lbs. (19-25 Nm).
7. Connect the front brake lines to the front anti-lock valve. Tighten the fittings to 140-200 inch lbs. (16-23 Nm).
8. Fill and bleed the brake system according to the proper procedure.

Rear Wheel Anti-Lock (RWAL) Valve

REMOVAL & INSTALLATION

Pick-Ups

➧ See Figures 88, 89, 90, 91 and 92

➥The combination valve must be removed with the RWAL valve.

1. Disconnect the ground wire and harness wire from the combination valve switch and RWAL valve.
2. Disconnect the lines to the front and rear brakes from the RWAL and combination valves.
3. Remove the brake lines connecting the master cylinder to the combination valve.
4. Remove the nuts attaching the master cylinder and combination valve bracket to the brake booster studs.
5. Remove the master cylinder.
6. Remove the combination valve, valve bracket and RWAL valve as an assembly.
7. Remove the brake line connecting the combination valve to the RWAL valve.
8. Remove the bolt attaching the RWAL valve to the combination valve bracket. Then separate the RWAL valve from the bracket.

To install:

9. Install the RWAL valve on the combination valve bracket. DO not tighten the RWAL valve bolt completely at this time.
10. Install the short brake line that connects the RWAL valve to the combination valve. Tighten the line fittings to 12-17 ft. lbs. (16-23 Nm).

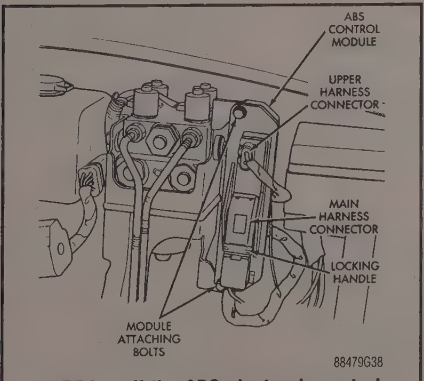


Fig. 85 Install the ABS electronic control module as shown—Dakota models

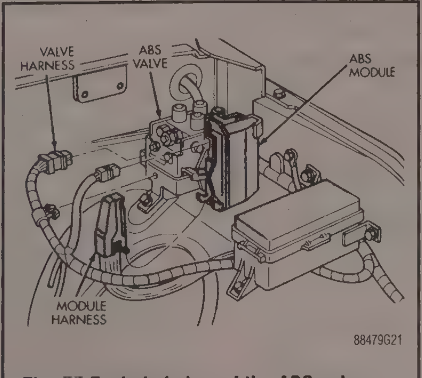


Fig. 86 Exploded view of the ABS valve and control module harness connections

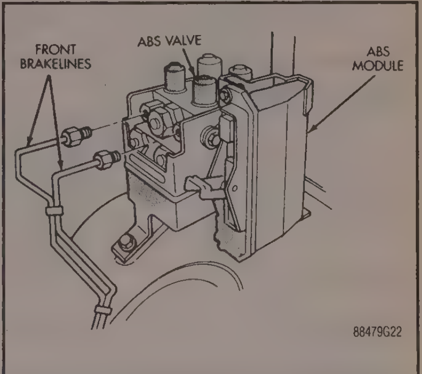


Fig. 87 Two front brake lines are fastened to the ABS valve

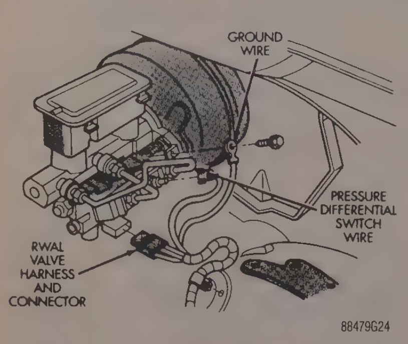

GROUND WIRE
PRESSURE DIFFERENTIAL SWITCH WIRE
RWAL VALVE HARNESS AND CONNECTOR
88479G24

Fig. 88 Location of the valve harness connector and ground wire

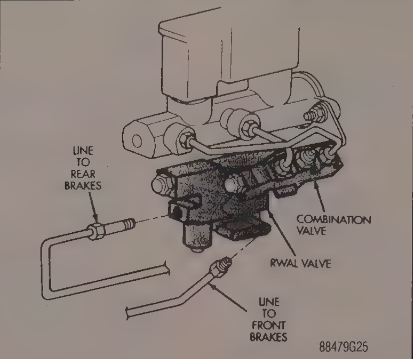

LINE TO REAR BRAKES
COMBINATION VALVE
RWAL VALVE
LINE TO FRONT BRAKES
88479G25

Fig. 89 Disconnect the master cylinder brake lines from the indicated ports

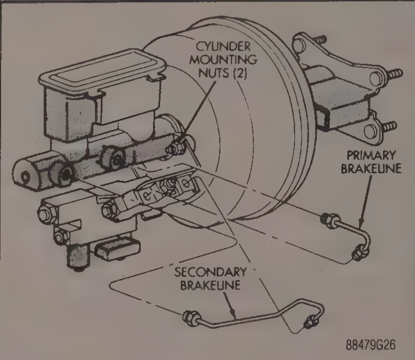

CYLINDER MOUNTING NUTS (2)
PRIMARY BRAKELINE
SECONDARY BRAKELINE
88479G26

Fig. 90 Exploded view of master cylinder brake line mounting

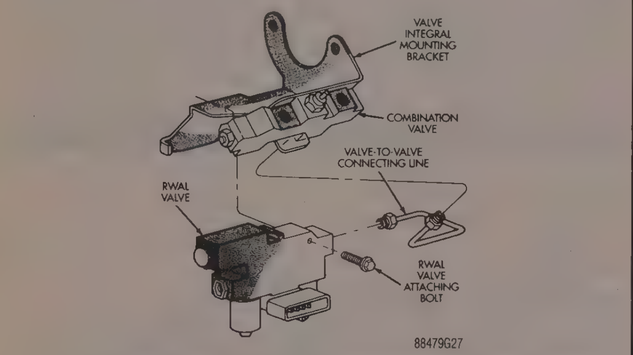

VALVE INTEGRAL MOUNTING BRACKET
COMBINATION VALVE
VALVE-TO-VALVE CONNECTING LINE
RWAL VALVE
RWAL VALVE ATTACHING BOLT
88479G27

Fig. 91 Exploded view of the RWAL valve/combination valve assembly

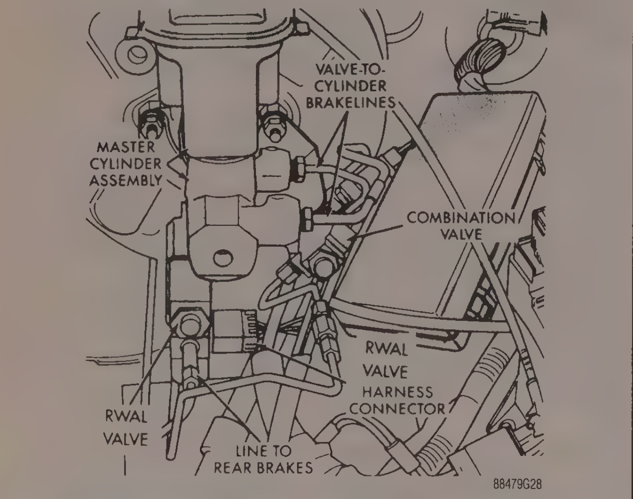

VALVE-TO-CYLINDER BRAKELINES
MASTER CYLINDER ASSEMBLY
COMBINATION VALVE
RWAL VALVE HARNESS CONNECTOR
RWAL VALVE
LINE TO REAR BRAKES
88479G28

Fig. 92 Note the various hydraulic brake lines, valves and fittings near the master cylinder

11. Tighten the RWAL valve attaching bolt to 17-25 ft. lbs. (23-34 Nm).
12. The remainder of installation is the reverse of removal. Tighten each component to specifications.
13. Fill and bleed the brake system according to the proper procedure.

Dakota Models

➡The combination valve must be removed with the rear anti-lock valve.

1. Disconnect and remove the battery for easier access to the valves and lines.
2. Disconnect the rear brake line at the rear anti-lock valve.
3. Disconnect the front brake line at the combination valve.
4. Disconnect the harness wires at the rear anti-lock and combination valves.
5. Disconnect the ground wire at the combination valve bracket. The wire may be attached at the top of the bracket or at the lower end.
6. Remove the nuts attaching the combination valve bracket to the brake booster studs.
7. Disconnect the brake lines connecting the rear anti-lock valve to the master cylinder.
8. Slide the combination valve bracket off the brake booster studs.
9. Remove the rear anti-lock valve, combination valve and bracket, and attached brake lines as an assembly.
10. Remove the brake line connecting the rear anti-lock valve to the combination valve.
11. Remove the bolt attaching the rear anti-lock valve to the combination valve bracket. Then, separate the rear anti-lock valve from the bracket.
12. Installation is the reverse of removal. Install the valve and bracket assembly on the brake booster mounting studs. Tighten the mounting nuts to 17-21 ft. lbs. (23-28 Nm).
13. Fill and bleed the brake system according to the proper procedure.

Combination Valve

TESTING

Metering Valve

The metering valve can be checked visually and with the aid of a helper.

1. While the helper applies and releases the brakes, observe the metering valve stem.
2. If the valve is operating correctly, the stem will extend slightly when the brakes are applied and retract when they are released.
3. If the valve is found faulty, replace the entire combination valve as an assembly.

Pressure Differential Switch

1. Have a helper sit in the driver's seat to apply the brake pedal and observe the red brake warning light.
2. Raise and safely support the vehicle.
3. Connect a bleed hose to a rear wheel cylinder and immerse the other end in a container partially filled with fluid.
4. Have the helper press and hold the brake pedal to the floor and watch the warning light.
   a. If the warning light illuminates, the switch os operating normally.
   b. If the light fails to illuminate, check the circuit fuse bulb and wiring. Repair as necessary and repeat this test.
5. If after making necessary repairs, the warning light still does not come on, check the brake light and parking brake switches and wiring with a test lamp to verify basic operation. Repair or replace parts as necessary and test the differential pressure switch operation again.
6. If the warning light still fails to illuminate, the switch is faulty. Replace

the combination valve assembly, bleed the brake system and verify proper switch and valve operation.

7. Lower the vehicle.

REMOVAL & INSTALLATION

➡The combination valve and mounting bracket are serviced as an assembly. They are permanently attached and should not be separated.

Pick-Ups

➧ See Figures 88, 89, 90, 91 and 92

1. Disconnect the ground wire and harness wire from the combination valve switch and RWAL valve.
2. Disconnect the lines to the front and rear brakes from the RWAL and combination valves.
3. Remove the brake lines connecting the master cylinder to the combination valve.
4. Remove the nuts attaching the master cylinder and combination valve bracket to booster studs.
5. Remove the master cylinder.
6. Remove the combination valve, valve bracket and RWAL valve as an assembly.
7. Remove the brake line connecting the combination valve to the RWAL valve.
8. Remove the bolt attaching the RWAL valve to the combination valve and bracket assembly. Then, separate the RWAL valve from the bracket.
9. Installation is the reverse of removal. Secure the short brake line that connects the RWAL valve to the combination valve. Tighten the line fittings to 12-17 ft. lbs. (16-23 Nm).
10. Tighten the RWAL valve attaching bolt to 17-25 ft. lbs. (23-34 Nm).
11. Fill and bleed the brake system according to the proper procedure.

Dakota Models

1. Disconnect and remove the battery for easier access to the valves and lines.
2. Disconnect the rear brake line at the rear anti-lock valve.
3. Disconnect the brake line from the front anti-lock valve at the combination valve.
4. Disconnect the harness wires at the rear anti-lock and combination valves.
5. Disconnect the ground wire at the combination valve bracket.
6. Remove the nuts attaching the combination valve bracket to the brake booster studs.
7. Disconnect the brake lines connecting the rear anti-lock valve to the master cylinder.
8. Slide the combination valve bracket off the brake booster studs.
9. Remove the rear anti-lock valve, combination valve and bracket, and attached brake lines as an assembly.
10. Remove the brake line connecting the rear anti-lock valve to the combination valve.
11. Remove the bolt attaching the rear anti-lock valve to the combination valve bracket. Then, separate the rear anti-lock valve from the bracket.
12. If the combination valve is to be replaced, remove the connecting brake lines from the valve.

To install:

13. If a new combination valve is being installed, transfer the brake lines that connect the valve to the master cylinder. Leave the fittings loose. Do not fully tighten them at this time.
14. Install the rear anti-lock valve on the combination valve bracket. Tighten the attaching bolt securely.
15. Install the brake line that connects the front anti-lock valve to the combination valve. Do not fully tighten the fitting at this time.
16. Install the valve and bracket assembly on the brake booster mounting studs. Tighten the mounting nuts to 17-21 ft. lbs. (23-28 Nm).
17. Attach the ground wire to the combination valve bracket. Make sure it is securely attached, and that the connection is clean.
18. Connect the brake lines to the master cylinder, rear anti-lock valve and combination valve. Tighten the fittings at the rear anti-lock valve to 10-15 ft. lbs. (13-20 Nm). Tighten all other line fittings to 12-17 ft. lbs. (16-23 Nm).
19. Connect the wire harnesses to the rear anti-lock and combination valves.
20. Install and connect the battery.
21. Fill and bleed the brake system according to the proper procedure.

Wheel Speed Sensors

Three wheel sensors are used in the 1993-96 all-wheel ABS system, one for each front wheel, and one to monitor both rear wheels.

The sensors convert wheel speed into an electrical signal which is transmitted to the electronic control module for processing.

TESTING

Wheel sensor malfunctions are generally caused by loose connections, damaged wires or incorrect sensor air gap. Also, if the tone wheel is physically damaged, or otherwise misaligned, the sensors will be unable to receive any information which will produce a fault code in the ABS module memory. For diagnosing a suspected faulty sensor, beyond a thorough visual inspection (such as when looking for an open or short), it is recommended that the DRB II scan tool, or equivalent, be used.

REMOVAL & INSTALLATION

Front Wheel

2WD DAKOTA MODELS

➧ See Figure 93

1. Raise and safely support the vehicle.
2. Remove the front wheel.
3. Remove the disc brake caliper.
4. Remove the disc brake hub and rotor assembly.
5. Remove the special bolts attaching the sensor to the splash shield. If these bolts are in good condition, keep them for reuse. If they are in need of replacement, you must replace them with the same type.
6. Remove the clamps securing the sensor wire to the control arm and inner fender.

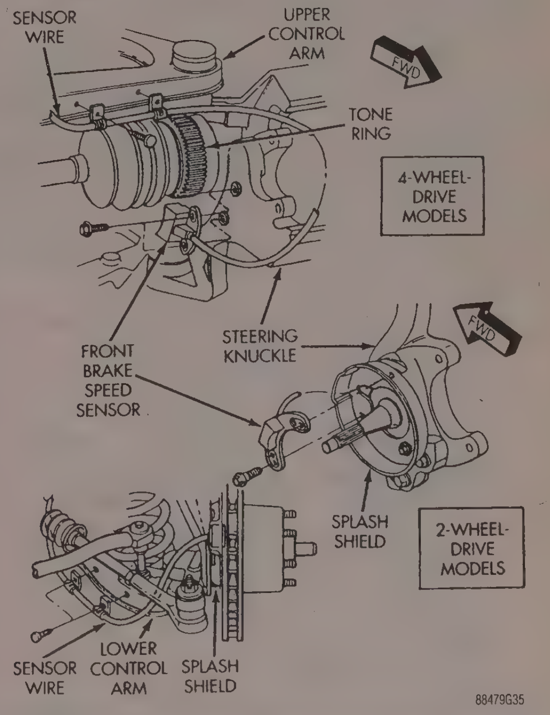


Fig. 93 Exploded view of the front wheel speed sensor mounting—Dakota models shown

7. Unseat the grommet securing the sensor wire in the fender panel.
8. In the engine compartment, unplug the sensor wire from the harness connector.
9. Remove the clamps securing the sensor wire to the engine compartment body panels.
10. Work the sensor wire out of the engine compartment and through the fender panel grommet hole. Then slide the wire out of the steering knuckle splash shield and out from the vehicle.

To install:

11. Guide the sensor wire through the splash shield, around the control arm and through the grommet hole in the fender panel. Do not seat the grommet in the fender panel at this time.
12. Position the sensor in the splash shield and install the special sensor attaching bolts. Tighten them to 13-18 ft. lbs. (18-25 Nm).
13. The remainder of installation is the reverse of removal. Tighten each component to specifications.

4WD DAKOTA MODELS

➧ See Figure 93

1. Raise and safely support the vehicle.
2. Remove the front wheel.
3. Remove the special bolts attaching the sensor to the steering knuckle. If the bolts are in good condition, keep them. Otherwise they will have to be replaced with new ones.
4. Remove the clamps that secure the sensor wire to the control arm and inner fender panel.
5. Unseat the grommet securing the sensor wire in the fender panel.
6. In the engine compartment, unplug the sensor wire from the harness connector.
7. Remove the clamps securing the sensor wire to the engine compartment body panels.
8. Work the sensor out of the engine compartment, through the fender panel grommet hole and out of the vehicle.
9. Installation is the reverse of removal. Secure the sensor attaching bolts to 13-18 ft. lbs. (18-25 Nm).

2WD PICK-UPS

➧ See Figure 94

1. Raise and safely support the front end of the vehicle.
2. Remove the wheel.
3. Use a prytool to press the caliper piston back into the bore.
4. Remove the brake caliper bolts, then lift the caliper from the knuckle and rotor. Use a wire to suspend the caliper from the frame or chassis. Do not let it hang freely from its hose.
5. Remove the rotor. Remove the special sensor attaching bolts. If they are in good condition, keep them for reuse. Otherwise, new bolts of the same type will have to be used. Disconnect the sensor wire and remove the sensor from the vehicle.
6. Installation is the reverse of removal. Secure the sensor bolt to 16-21 ft. lbs. (21-25 Nm).

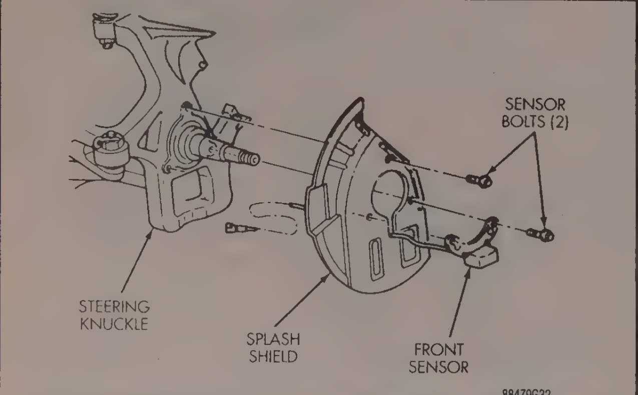


Fig. 94 Exploded view of the front wheel speed sensor mounting—2WD Pick-up design shown

4WD PICK-UPS

1. Remove the bolt attaching the sensor to the inside of the steering knuckle.
2. In the engine compartment, unplug the sensor wire connector at the harness plug.
3. Remove the sensor and wire assembly.
4. Installation is the reverse of removal. Secure the sensor attaching bolt to 11 ft. lbs. (14 Nm).

Rear Wheel

DAKOTA MODELS

➧ See Figure 95

1. Raise the rear of the vehicle.
2. Unplug the wire from the sensor on the axle housing.
3. Unplug the sensor wire from the harness connector at the driver's side frame rail.
4. Unclip the sensor wire from the rear brake hose, then remove the sensor wire from the vehicle. Installation is the reverse of removal.

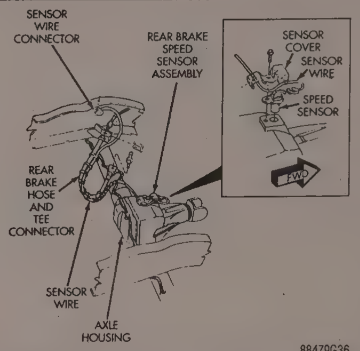


Fig. 95 Exploded view of the rear wheel speed sensor mounting—Dakota models

PICK-UPS

➧ See Figure 96

1. Raise and safely support the rear of the vehicle.
2. Locate the sensor, its cover and mounting area on the axle and clean before proceeding.
3. Unplug the harness wires from the sensor.

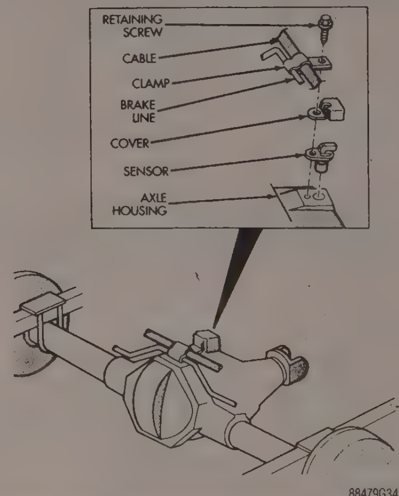


Fig. 96 Exploded view of the rear wheel speed sensor mounting—Pick-up models

4. Remove the screw that secures the brake cable, brake line, sensor cover and sensor axle housing.
5. Remove the sensor and cover.
6. Cover the sensor opening in the axle housing to prevent dirt entry.
7. Installation is the reverse of removal. Secure the cover and cover attaching screw to 18 ft. lbs. (24 Nm).

Tone Wheel

FRONT

➧ See Figure 97

The tone wheel for each front wheel sensor is mounted to the inner rotor hub on 2WD vehicles, and on the axle outer stub shaft on 4WD vehicles.

The tone wheel is not a serviceable component. To replace the tone wheel on 2WD models, the complete rotor and hub assembly must be replaced. On 4WD models, the driveshaft will have to be removed and the axle outer stub shaft replaced, if the tone wheel is damaged. Please refer to the appropriate sections in this manual to service these components.

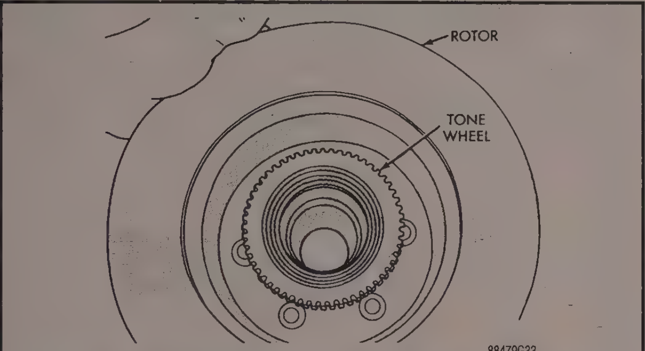


Fig. 97 The front tone wheel is mounted to the inner rotor hub on 2WD vehicles

REAR

The rear tone wheel is more commonly called the "exciter ring" and is an integral component of the Rear Wheel Anti-Lock (RWAL) system, as well as the all-wheel ABS system. To remove or install, it requires removal of the rear differential. For service information, please refer to Section 7.

Filling and Bleeding

FILLING THE SYSTEM

1. Turn the ignition **OFF** and leave it **OFF** during inspection.
2. Thoroughly clean the reservoir cap and the surrounding area.
3. Carefully remove reservoir cap, keeping all dirt out of the reservoir. Inspect the fluid level; fill to the top of the white screen in the front strainer if required. Do not overfill. Use only fresh DOT 3 brake fluid from unopened containers. Do not use any fluid containing a petroleum base. Do not use any fluid which has been exposed to water or moisture. Failure to use the correct fluid will affect system function and component life.
4. Install the reservoir cap.

BLEEDING THE SYSTEM

Bleeding may be done either manually, or with vacuum/pressure equipment. Bleed only one brake component at a time. The recommended bleed sequence is:

- Master cylinder
- Combination Valve
- Rear anti-lock valve
- Front anti-lock valve
- Left rear wheel
- Right rear wheel
- Right front wheel
- Left front wheel

Manual Bleeding

The individual lines may be bled manually at each wheel using the traditional 2-person method.

➡Use DOT 3 brake fluid, or an equivalent meeting SAE J1703-F and DOT 3 standards.

Bleed a new or overhauled master cylinder on the bench before installation.

1. Components should be bled in the proper order. Connect a transparent hose to the bleed screw. Submerge the other end of the hose in clean brake fluid in a clear glass container.
2. Have a helper press and HOLD the brake pedal to the floor. Observe the condition of the escaping fluid.
3. Tighten the fitting, then have the helper release the brake pedal.
4. Repeat Steps 2 and 3 until air-free fluid flows from the hose. Tighten the caliper bleed screw to 60-84 inch lbs. (7-9 Nm).
5. Repeat the sequence at each remaining caliper and wheel cylinder.

➡Check the fluid level in the reservoir frequently and maintain it near the full level.

6. When the bleeding is complete, bring the fluid level in the reservoir to the correct level. Install the reservoir cap.

WITH NEW FRONT ANTI-LOCK VALVE

➧ See Figures 98 and 99

If a new front anti-lock valve assembly was installed, bleed it as follows:

1. Loosen the bleed plug on the new front valve about ¼ to 1 full turn. The plug must be open to completely bleed the upper and lower portions of the valve.
2. Remove the bleeder valve cap, then install a valve depressor tool, such as tool No. 6670, or equivalent, on the bleed valve stem by sliding the notched side of the tool onto the boss that surrounds the bleed valve stem.
3. Tighten the thumbscrew on the special tool enough to push the stem in about 0.020-0.030 in. (0.51-0.76mm). The stem must be held inward (open position) to completely bleed the upper portion of the new valve assembly.
4. Apply the brake pedal. The pedal will fall off significantly if the tool is correctly installed.
5. Stroke the brake pedal rapidly about 5-10 times. This action will fill the upper and lower portions of the valve rapidly.
6. Bleed the new valve assembly at each brake line fitting, one at a time. Remember to close the valve bleed plug before each brake pedal stroke.

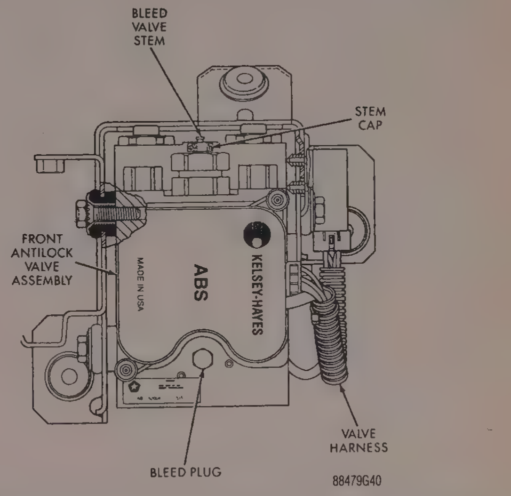


Fig. 98 Location of the front anti-lock valve bleed valve stem and bleed plug

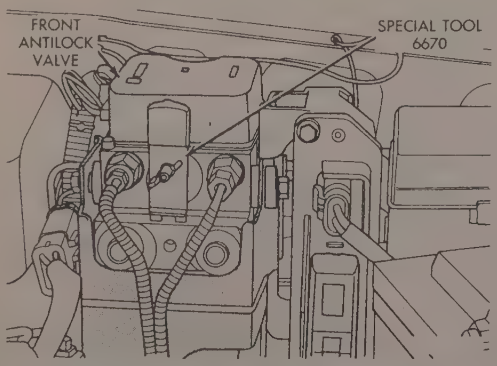


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Fig. 90 Installation of the bleed valve depressor tool

7. Repeat the bleeding sequence for each brake line fitting until air-free fluid flows from the hose. Tighten the caliper bleed screw to 60-84 inch lbs. (7-9 Nm).

WITH ORIGINAL FRONT ANTI-LOCK VALVE

If the original assembly is being used, the bleed plug and bleed valve do not have to be open during the bleeding operations. Just bleed the valve assembly at each brake line fitting one at a time.

Bleed the first wheel brake unit and follow through in the proper sequence. When the fluid is clear and free of bubbles, tighten the caliper bleed screw to 60-84 inch lbs. (7-9 Nm). Then top off the master cylinder and verify the brakes operate properly.

Vacuum Bleeding

If vacuum bleeding equipment is being used, it is not necessary to hold the front metering valve open. Simply bleed the brakes following the bleed equipment manufacturer's instructions.

Pressure Bleeding

If pressure bleeding equipment is being used, the front brake metering valve will have to be held open to bleed the front brake lines. The valve stem is located in the forward end of the combination valve. The stem must be either pressed inward, or held outward slightly. A spring clip tool or a helper is needed to hold the valve stem in position.

Follow the equipment manufacturer's instructions when bleeding the brake lines. Generally a tank pressure of 15-20 psi (103-138 kPa) is more than sufficient for bleeding purposes. Do not exceed the tank manufacturer's pressure recommendations.

Fill the bleeder tank with the recommended fluid and purge the air from the tank prior to bleeding the lines.

✲✲ WARNING

Do not pressure bleed without a proper master cylinder adapter. The wrong adapter can lead to leakage or drawing air back into the system.

Make sure the front brake metering valve in the combination valve is held open. A spring clip tool is best for securing the valve stem in an open position.

BRAKE SPECIFICATIONS

All measurements in inches unless noted

			Brake Disc			Brake Drum Diameter			Minimum Lining Thickness	
Year	Model	Master Cylinder Bore	Original Thickness	Minimum Thickness	Maximum Run-out	Original Inside Diameter	Max. Wear Limit	Maximum Machine Diameter	Front	Rear
1989	D150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	W150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	D250 Pick-up	1.125	1.24	1.18	0.005	12.00	12.09	12.06	0.062	0.062
	W250 Pick-up	1.125	[1]	[2]	0.005	12.00	12.09	12.06	0.062	0.062
	D350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	W350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	Ramcharger	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	Dakota	NA	0.861	0.810	0.004	9.00	9.09	9.06	0.06	0.06
	Dakota	NA	0.861	0.810	0.004	10.00	10.09	10.06	0.06	0.06
1990	D150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	W150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	D250 Pick-up	1.125	1.24	1.18	0.005	12.00	12.09	12.06	0.062	0.062
	W250 Pick-up	1.125	[1]	[2]	0.005	12.00	12.09	12.06	0.062	0.062
	D350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	W350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	Ramcharger	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	Dakota	NA	0.861	0.810	0.004	9.00	9.09	9.06	0.06	0.06
	Dakota	NA	0.861	0.810	0.004	10.00	10.09	10.06	0.06	0.06
1991	D150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	W150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	D250 Pick-up	1.125	1.24	1.18	0.005	12.00	12.09	11.06	0.062	0.062
	W250 Pick-up	1.125	[1]	[2]	0.005	12.00	12.09	12.06	0.062	0.062
	D350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	W350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	Ramcharger	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	Dakota	NA	0.861	0.810	0.004	10.00	10.09	10.06	0.06	0.06
	Dakota	NA	0.861	0.810	0.004	9.00	9.09	9.06	0.06	0.06
1992	D150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	W150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	D250 Pick-up	1.125	1.24	1.18	0.005	12.00	12.09	11.06	0.062	0.062
	W250 Pick-up	1.125	[1]	[2]	0.005	12.00	12.09	12.06	0.062	0.062
	D350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	W350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	Ramcharger	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	Dakota	NA	0.861	0.810	0.004	9.00	9.09	9.06	0.06	0.06
	Dakota	NA	0.861	0.810	0.004	10.00	10.09	110.06	0.06	0.06

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BRAKE SPECIFICATIONS

All measurements in inches unless noted

		Master	Brake Disc			Brake Drum Diameter			Minimum Lining Thickness	
Year	Model	Cylinder Bore	Original Thickness	Minimum Thickness	Maximum Run-out	Original Inside Diameter	Max. Wear Limit	Maximum Machine Diameter	Front	Rear
1993	D150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	W150 Pick-up	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	D250 Pick-up	1.125	1.24	1.18	0.005	12.00	12.09	11.06	0.062	0.062
	W250 Pick-up	1.125	[1]	[2]	0.005	12.00	12.09	12.06	0.062	0.062
	D350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	W350 Pick-up	1.125	1.18	1.125	0.005	12.00	12.09	12.06	0.062	0.062
	Ramcharger	1.125	1.24	1.18	0.004	11.00	11.09	11.06	0.062	0.062
	Dakota	NA	0.861	0.810	0.004	9.00	9.09	9.06	0.06	0.06
	Dakota	NA	0.861	0.810	0.004	10.00	10.09	10.06	0.06	0.06
1994	D1500 Pick-up	1.125	1.26	[3]	0.004	11.00	11.09	11.06	0.062	0.062 [4]
	W1500 Pick-up	1.125	1.26	[3]	0.004	11.00	11.09	11.06	0.062	0.062 [4]
	D2500 Pick-up	1.250	1.50	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	W2500 Pick-up	1.250	1.50	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	D3500 Pick-up	1.250	1.50	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	W3500 Pick-up	1.250	1.50	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	Dakota	NA	0.861	0.810	0.004	9.00	9.09	9.06	0.06	0.06 [4]
	Dakota	NA	0.861	0.810	0.004	10.00	10.09	10.06	0.06	0.06 [4]
1995	D1500 Pick-up	1.125	1.260	[3]	0.004	11.00	11.09	11.06	0.062	0.062 [4]
	W1500 Pick-up	1.125	1.260	[3]	0.004	11.00	11.09	11.06	0.062	0.062 [4]
	D2500 Pick-up	1.250	1.500	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	W2500 Pick-up	1.250	1.500	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	D3500 Pick-up	1.250	1.500	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	W3500 Pick-up	1.250	1.500	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	Dakota	NA	0.861	0.810	0.004	9.00	9.09	9.06	0.060	0.060 [4]
	Dakota	NA	0.861	0.810	0.004	10.00	10.09	10.06	0.060	0.060 [4]
1996	D1500 Pick-up	1.125	1.260	[3]	0.004	11.00	11.09	11.06	0.062	0.062 [4]
	W1500 Pick-up	1.125	1.260	[3]	0.004	11.00	11.09	11.06	0.062	0.062 [4]
	D2500 Pick-up	1.250	1.500	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	W2500 Pick-up	1.250	1.500	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	D3500 Pick-up	1.250	1.500	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	W3500 Pick-up	1.250	1.500	[3]	0.005	13.00	13.09	13.06	0.062	0.062 [4]
	Dakota	NA	0.861	0.810	0.004	9.00	9.09	9.06	0.060	0.060 [4]
	Dakota	NA	0.861	0.810	0.004	10.00	10.09	10.06	0.060	0.060 [4]

NA - Not Available

[1] With 3300 lb. or 3600 lb. rear axle: 1.24 in.
With 4000 lb. rear axle: 1.18 in.

[2] With 3300 lb. or 3600 lb. rear axle: 1.180 in.
With 4000 lb. rear axle: 1.125 in.

[3] Minimum thickness indicated on rotor hub

[4] For riveted brake shoes: 0.031 in.

88479C07

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10

BODY AND TRIM

EXTERIOR 10-2
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EXTERIOR

Doors

ADJUSTMENT

➡Loosen the hinge-to-door bolts for lateral adjustment only. Loosen the hinge-to-body bolts for both lateral and vertical adjustment.

1. Determine which hinge bolts are to be loosened and back them out just enough to allow movement.
2. To move the door safely, use a padded pry bar. When the door is in the proper position, tighten the bolts to 30 ft. lbs. (41 Nm) and check the door operation. There should be no binding or interference when the door is closed and opened.
3. Door closing adjustment can also be affected by the position of the lock striker plate. Loosen the striker plate bolts and move the striker plate just enough to permit proper closing and locking of the door.

Hood

REMOVAL & INSTALLATION

➧ See Figures 1 and 2

➡You'll need an assistant for this job.

1. Open the hood.
2. Matchmark the hood-to-hinge position.
3. Remove the hood-to-hinge bolts and lift off the hood.
4. Install in reverse order. Loosely install the hood and align the matchmarks. Tighten all bolts to 20 ft. lbs. (27 Nm).

Fig. 1 Matchmark the hood to allow proper alignment upon reinstallation

ADJUSTMENT

➧ See Figures 3 and 4

1. Open the hood and matchmark the hinge and latch positions.
2. Loosen the hinge-to-hood bolts just enough to allow movement of the hood.
3. Loosen the hood lock at the grille support.
4. Close the hood and move it so that you have a 1⁄16 in. (1.5mm) clearance between the back of the hood and the cowl.
5. Raise the hood no more than 30° and tighten the hood-to-hinge bolts.
6. Tighten the latch, lower the hood and check for even pressure at the fender pads. Open the hood and, using modeling clay, apply the substance to the top side of the primary latch striker arm. Close the hood and make sure it is fully latched. Open the hood and check the latch imprint in the clay. A properly adjusted latch will show a centered imprint on the striker. If not, adjust the hood latch.

Hatchgate

REMOVAL & INSTALLATION

✲✲ CAUTION

Do not disconnect a support rod with the hatchgate closed. The support rod pistons are gas-pressurized and could cause damage and/or personal injury if they are removed while the pistons are compressed.

1. Open and support the hatchgate.
2. Remove the hinge-to-roof panel screws.
3. Remove the support rod upper bolts from the rear pillar.
4. Remove the hatchgate and support rods from the truck.

To install:

5. Position and support the hatchgate in the vehicle opening with the hinge screw holes aligned.
6. Align the support rod bolt holes and install the retaining nuts and bolts. Tighten the bolts to 17 ft. lbs. (23 Nm).
7. Test the hatchgate and hinge operation. Add spacers for hinge adjustment, if necessary.

Tailgate

REMOVAL & INSTALLATION

➧ See Figures 5, 6 and 7

1. Open the tailgate.
2. Angle the gate so the slot in the check arm lines up with the body hinge.

Fig. 2 Remove the bolts securing the hood, then lift it out with the help of an assistant

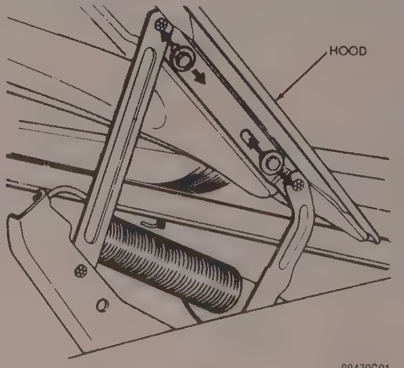


Fig. 3 Hood adjusting points

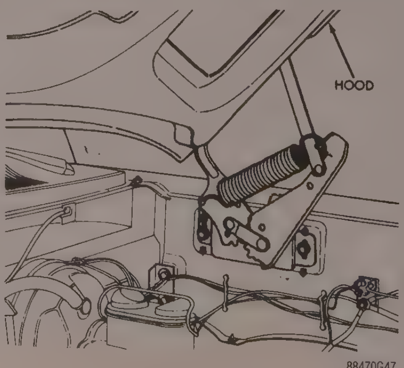


Fig. 4 Hood hinge-to-body adjusting points

3. Slip the check arm away from the hinge. On cable types, use a small prytool to disengage it from its support pin.
4. Remove the bottom of the gate from the slot in the lower hinge on the right side, facing the gate.
5. Remove the left side of the gate by sliding it out of the lower hinge.

Install in reverse order.

Bumpers

REMOVAL & INSTALLATION

See Figures 8, 9, 10, 11 and 12

1. Support the bumper.
2. Remove the bolts attaching the bumper to the frame.
3. Remove the bumper from the vehicle.

To install:

4. Install the bumper onto the bumper brackets.
5. Tighten the bracket-to-frame bolts to 100 ft. lbs. (135 Nm).

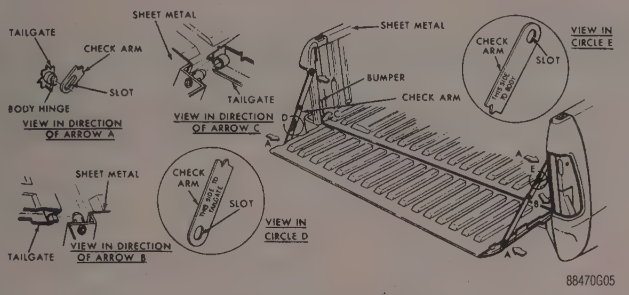

TAILGATE
SHEET METAL
CHECK ARM
SLOT
BODY HINGE
VIEW IN DIRECTION OF ARROW A
SHEET METAL
TAILGATE
VIEW IN DIRECTION OF ARROW C
SHEET METAL
BUMPER
CHECK ARM
D
A
E
CHECK ARM
SLOT
THIS SIDE TO BODY
VIEW IN CIRCLE E
SHEET METAL
TAILGATE
VIEW IN DIRECTION OF ARROW B
CHECK ARM
THIS SIDE TO TAILGATE
SLOT
VIEW IN CIRCLE D
B
A
88470G05

Fig. 5 Details of the tailgate hardware—Pick-up shown

Grille

REMOVAL & INSTALLATION

See Figures 13, 14, 15, 16 and 17

1. Remove the grille upper screws.
2. Unfasten the grille lower screws.
3. Remove the attaching screws at each end of the grille.
4. Unfasten the screws at each end of the extension.
5. Remove the grille.

To install:

6. Place the grille extensions in position, then install all the screws loosely.
7. Center the grille extensions and tighten the screws.
8. Place the grille in the opening and center it, then install and tighten all the screws.

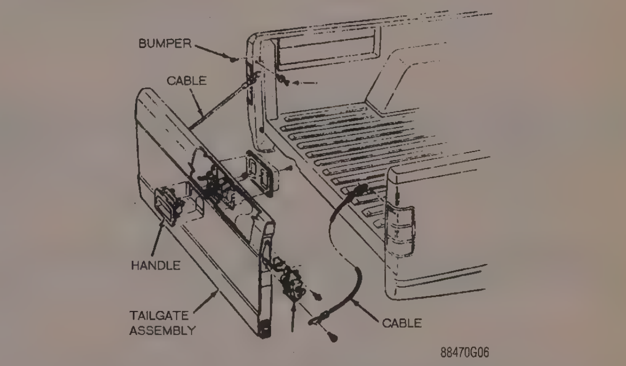

BUMPER
CABLE
HANDLE
TAILGATE ASSEMBLY
CABLE
88470G06

Fig. 6 Exploded view of the Dakota tailgate mounting

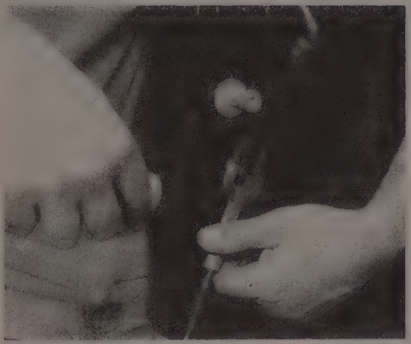


Fig. 7 On cable types, use a suitable prytool to separate the end from the pin

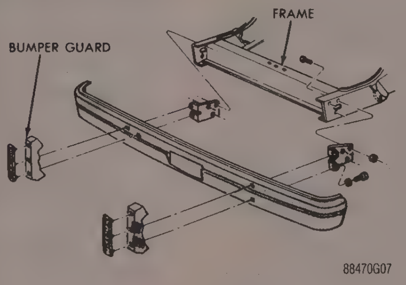

FRAME
BUMPER GUARD
88470G07

Fig. 8 Exploded view of the front bumper mounting—150–350 series Pick-ups

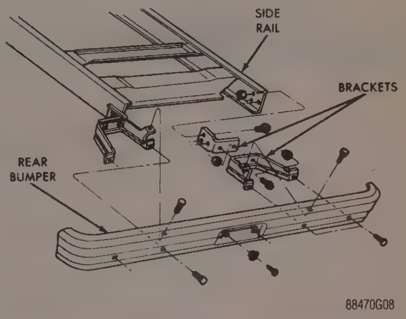

SIDE RAIL
BRACKETS
REAR BUMPER
88470G08

Fig. 9 Exploded view of the rear bumper mounting—150–350 series Pick-ups

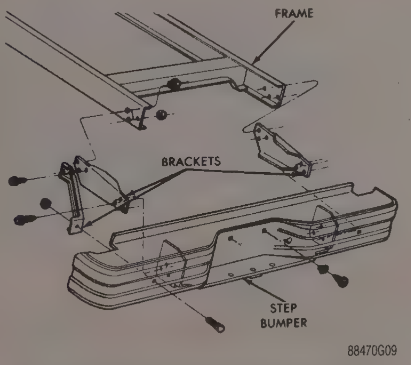

FRAME
BRACKETS
STEP BUMPER
88470G09

Fig. 10 Exploded view of the rear step bumper mounting—150–350 series Pick-ups

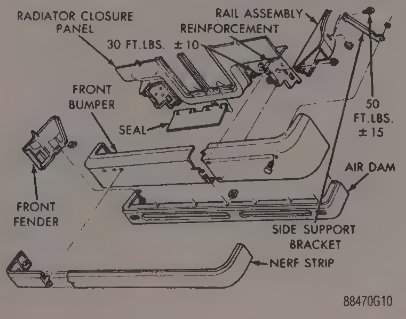

RADIATOR CLOSURE PANEL
RAIL ASSEMBLY
REINFORCEMENT
30 FT.LBS. ± 10
FRONT BUMPER
SEAL
50 FT.LBS. ± 15
AIR DAM
FRONT FENDER
SIDE SUPPORT BRACKET
NERF STRIP
88470G10

Fig. 11 Exploded view of the front bumper mounting—Dakota models

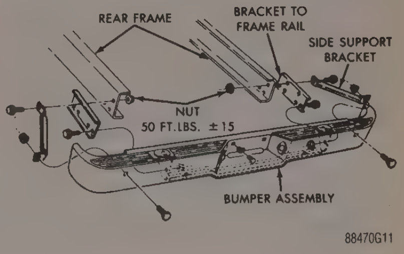

REAR FRAME
BRACKET TO FRAME RAIL
SIDE SUPPORT BRACKET
NUT
50 FT.LBS. ± 15
BUMPER ASSEMBLY
88470G11

Fig. 12 Exploded view of the rear bumper mounting—Dakota models

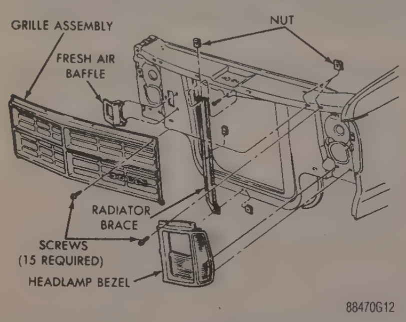

GRILLE ASSEMBLY
NUT
FRESH AIR BAFFLE
RADIATOR BRACE
SCREWS (15 REQUIRED)
HEADLAMP BEZEL
88470G12

Fig. 13 Exploded view of the Dakota grille assembly

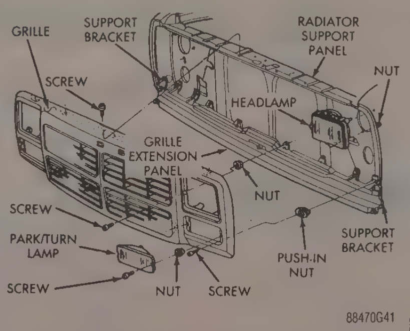

GRILLE
SUPPORT BRACKET
RADIATOR SUPPORT PANEL
NUT
SCREW
HEADLAMP
GRILLE EXTENSION PANEL
NUT
SCREW
PARK/TURN LAMP
SCREW
NUT
SCREW
PUSH-IN NUT
SUPPORT BRACKET
88470G41

Fig. 14 Exploded view of the 150–350 series Pick-up and Ramcharger grille—1991 models shown

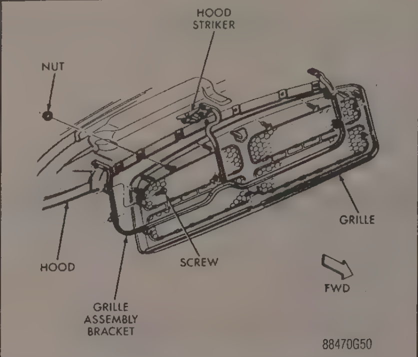

HOOD STRIKER
NUT
GRILLE
HOOD
SCREW
FWD
GRILLE ASSEMBLY BRACKET
88470G50

Fig. 15 Exploded view of the grille assembly mounting—1994–96 Pick-ups

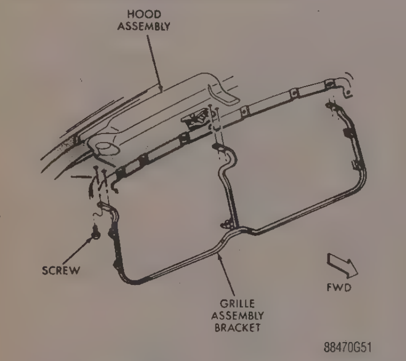

HOOD ASSEMBLY
SCREW
GRILLE ASSEMBLY BRACKET
FWD
88470G51

Fig. 16 Exploded view of the grille mounting frame—1994–96 Pick-ups

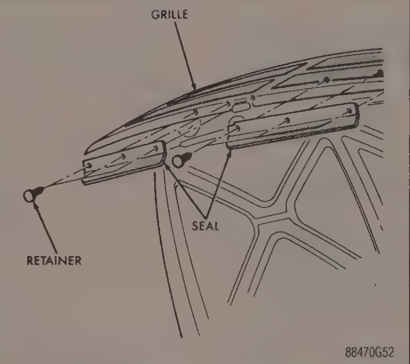

GRILLE
SEAL
RETAINER
88470G52

Fig. 17 Grille seals as found on the 1994–96 Pick-ups

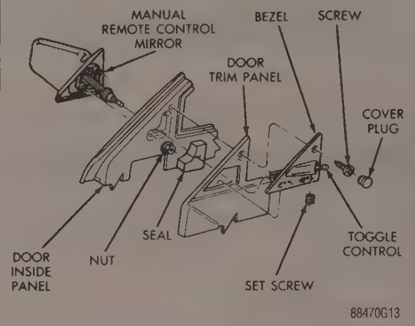

MANUAL REMOTE CONTROL MIRROR
BEZEL
SCREW
DOOR TRIM PANEL
COVER PLUG
TOGGLE CONTROL
SEAL
NUT
DOOR INSIDE PANEL
SET SCREW
88470G13

Fig. 18 Exploded view of the Dakota remote manual mirror assembly

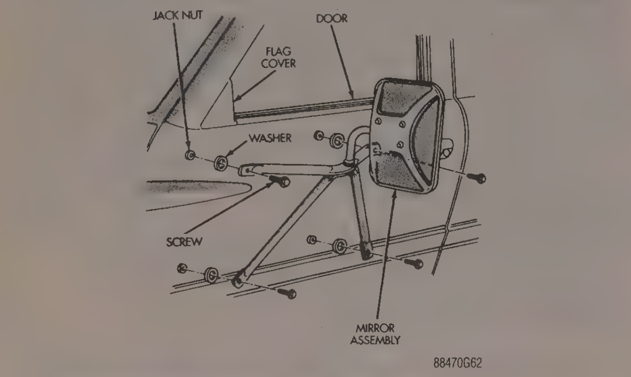

JACK NUT
DOOR
FLAG COVER
WASHER
SCREW
MIRROR ASSEMBLY
88470G62

Fig. 19 Mounting position of a wide view mirror

Outside Mirrors

REMOVAL & INSTALLATION

➧ See Figures 18 and 19

All D/W-series standard and wide-view exterior mirrors are removed by removing the mounting screws and lifting off the mirror and gasket. Low-profile wide-view mirrors are removed as an assembly by removing the 4 mirror brace mounting screws from the door.

On Dakotas, loosen the mirror toggle control setscrew at the bezel, then remove the cover plug and mirror bezel retaining screw. Remove the mirror bezel and seal to gain access to the mirror mounting screws.

Antenna

REMOVAL & INSTALLATION

➧ See Figures 20, 21 and 22

1. Disconnect the battery ground.
2. Remove the glove box.
3. Reach behind the instrument panel and unplug the antenna lead from the radio.
4. Reach through the glove box opening and pull the antenna lead out of the retainer clip.
5. Open the right door and remove the cable grommet from the A-pillar.
6. Pull the cable from the A-pillar.
7. Loosen, but do not remove, the antenna mast.
8. Loosen the capnut on the adapter.
9. Hold the antenna mast in one hand and remove the capnut with the other.
10. Lower the antenna far enough to gain access to the antenna body.
11. While holding the antenna body, remove the antenna mast.
12. Pull the antenna body and cable from the fender.
13. Remove the adapter from the fender.

To install:

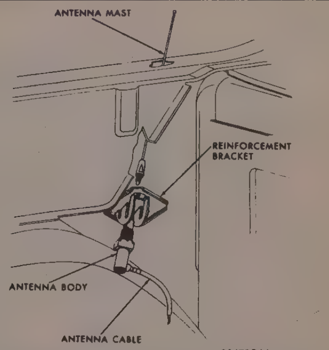
14. Route the antenna cable between the fender and firewall to the A-pillar.
15. Insert the mast through the hole in the fender and screw it into the antenna body.
16. Pull the assembly into position and hold it there.
17. Install the adapter and index the tab with the opening in the fender and antenna body.
18. Install the capnut and tighten it securely.
19. Insert the cable through the opening in the A-pillar.

88470P05

Fig. 20 Unfasten the glove box mounting screws

88470P06

Fig. 21 When fully detached, remove the glove box from the vehicle



88470G14

Fig. 22 Mounting position of a common Dodge truck antenna

20. From inside the glove box opening, pull the cable in far enough to snap the grommet into place.
21. Route the cable through the clip and plug it into the radio.
22. Install the glove box.
23. Connect the battery.

INTERIOR

Instrument Panel

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable. On vehicles with air bags, isolate the cable and wait at least two minutes before continuing with the procedure.
2. Remove the instrument cluster bezel and cluster assembly from the instrument panel.
3. Remove the attaching bolts, then carefully lower the steering column onto the seat.
4. Remove the glove box.
5. Label and disconnect the control cables and vacuum hoses from the heater/air conditioner unit.
6. Remove the fasteners securing the instrument panel.
7. Carefully pull the panel out and unplug any remaining electrical connections as necessary.
8. Remove the panel from the vehicle.

To install:

9. Position the panel in the vehicle and engage any electrical connections which cannot be accessed with the panel installed.
10. Install the panel retaining hardware.
11. Connect the hoses and cables to the heater;BSair conditioner unit. Refer to Section 6 for more information.
12. Install the glove box.
13. Raise and install the steering column.
14. Install the instrument cluster and bezel.
15. Connect the negative battery cable.
16. Start the vehicle and check for proper operation of the components.

Floor Console

REMOVAL & INSTALLATION

1. Open the console lid.
2. Remove the console retaining screws from the floor panel.
3. Remove the console from the floor.
4. To install, position the console on the floor. Install the screws.

Door Trim Panels

REMOVAL & INSTALLATION

➧ See Figures 23 thru 32

1. Remove the armrest.
2. Remove the door handle screw and pull off the handle.
3. On models with manual windows, remove the window regulator handle screw and pull off the handle. If not fastened with a screw, slip a suitable door handle removal tool behind the handle and detach it from its mounting to the regulator.
4. On models with power windows, remove the power window switch housing.

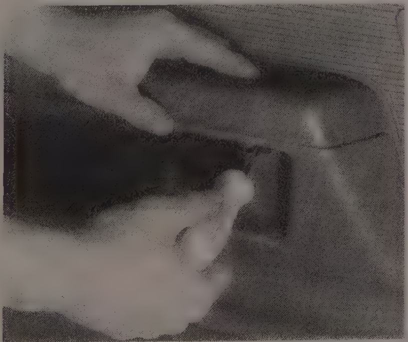

88470P03

Fig. 23 Remove the screws securing the armrest

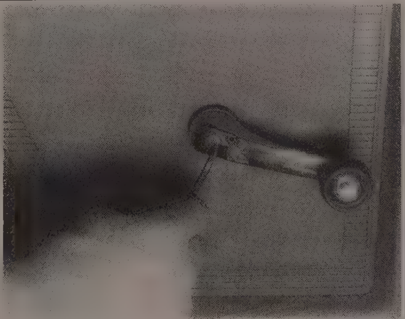

88470P01

Fig. 24 Unscrew and remove the door handle—on this 1990 Pick-up, it is secured with a hex head screw

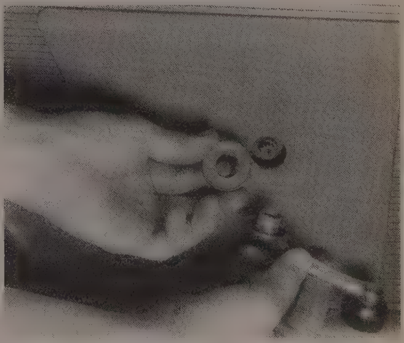

88470P02

Fig. 25 Take note of the correct order of the parts removed

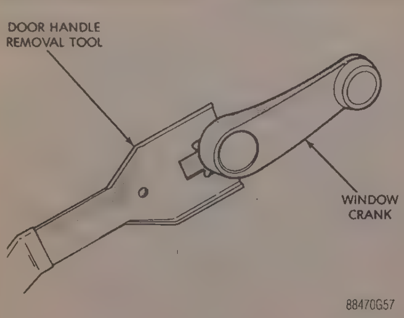

DOOR HANDLE REMOVAL TOOL
WINDOW CRANK
88470G57

Fig. 26 Some door handles require a special tool for removal—1994–96 Pick-up type shown

Fig. 27 Remove the door trim panel with a suitable panel separator tool

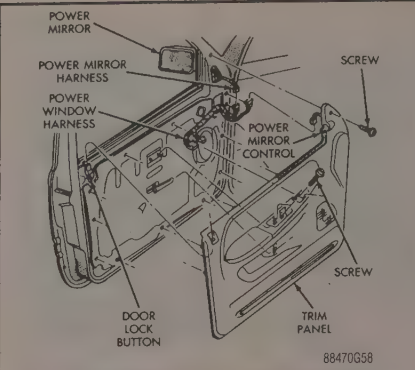

POWER MIRROR
POWER MIRROR HARNESS
POWER WINDOW HARNESS
SCREW
POWER MIRROR CONTROL
SCREW
DOOR LOCK BUTTON
TRIM PANEL
88470G58

Fig. 28 Exploded view of the door panel mounting—1994–96 Pick-ups

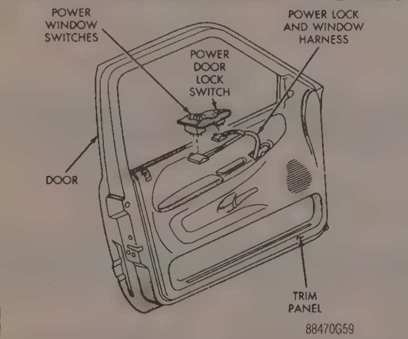

POWER WINDOW SWITCHES
POWER LOCK AND WINDOW HARNESS
POWER DOOR LOCK SWITCH
DOOR
TRIM PANEL
88470G59

Fig. 29 Some accessory switch controls will have to be removed prior to panel removal—1994–96 Pick-ups

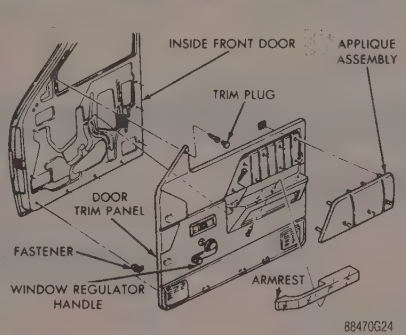

INSIDE FRONT DOOR
APPLIQUE ASSEMBLY
TRIM PLUG
DOOR TRIM PANEL
FASTENER
WINDOW REGULATOR HANDLE
ARMREST
88470G24

Fig. 30 Exploded view of the Dakota door trim panel mounting

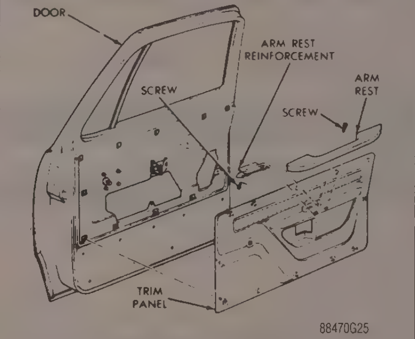

DOOR
ARM REST REINFORCEMENT
ARM REST
SCREW
SCREW
TRIM PANEL
88470G25

Fig. 31 Exploded view of the door trim panel mounting—150–350 series Pick-up and Ramcharger

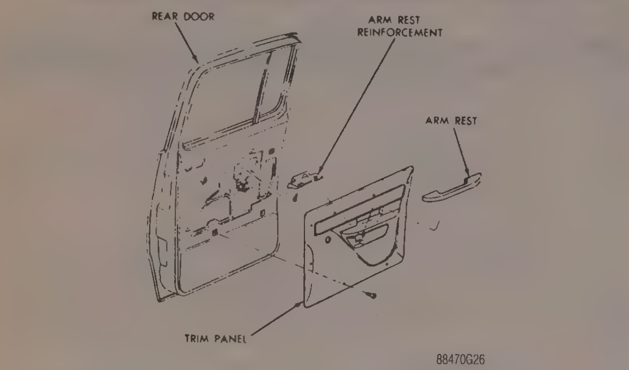

REAR DOOR
ARM REST REINFORCEMENT
ARM REST
TRIM PANEL
88470G26

Fig. 32 Exploded view of the rear door trim panel mounting

5. On models with manual door locks, remove the door lock control. On models with power door locks, remove the power door lock switch housing.
6. On models with electric outside rear view mirrors, remove the power mirror switch housing.
7. Using a flat wood spatula, or equivalent tool, insert it carefully behind the panel and slide it along to find the push-pins. When you encounter a pin, pry the pin outward. Do this until all the pins are out. NEVER PULL ON THE PANEL TO REMOVE THE PINS!

To install:

8. Install by positioning the panel on the door and pressing the pins into position.
9. On models with electric outside rear view mirrors, install the power mirror switch housing.
10. On models with manual door locks, install the door lock control.
11. On models with power door locks, install the power door lock switch housing.
12. On models with manual windows, install the window regulator handle.
13. On models with power windows, install the power window switch housing.
14. Install the door handle.
15. Install the armrest.

Interior Trim Panels

REMOVAL & INSTALLATION

All interior trim panels are attached with screws and/or clip retainers. Do not attempt to remove trim panels or moldings without first removing or loosening any overlapping or adjacent panels or other interfering components, such as coat hangers. To avoid damage, make sure all screws and/or retainer clips are removed before attempting to remove an panel or molding. Trim panels are somewhat flexible but can be damaged if handled improperly.

To ensure correct alignment when installing trim panels, install the retaining screws finger-tight, then align the panels at each end before tightening the screws. Be careful not to overtighten the screws. Typical screw torque is only 12 inch lbs. (1 Nm).

Manual Door Locks

REMOVAL & INSTALLATION

Front Door Latch

➧ See Figure 33

1. Raise the glass to the full UP position.
2. Remove the door trim panel and watershield.
3. Disconnect the clips and/or rods from the handle and lock cylinder, and from the remote control assembly.
4. Remove the latch assembly attaching screws and remove the latch from the door.
5. Install in the reverse order of removal.

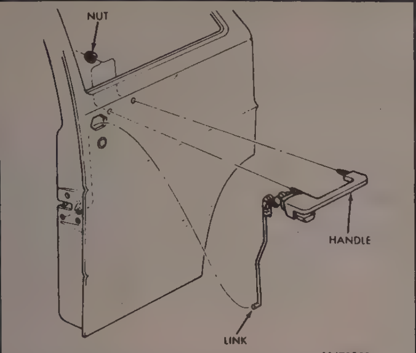

NUT
HANDLE
LINK
88470G28

Fig. 33 Exploded view of a common door handle mounting

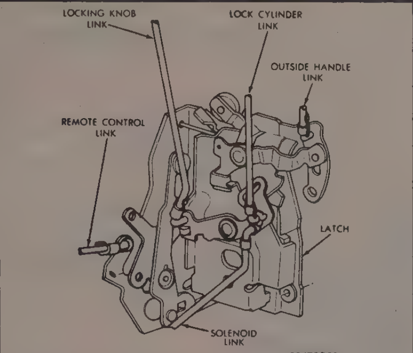

LOCKING KNOB LINK
LOCK CYLINDER LINK
OUTSIDE HANDLE LINK
REMOTE CONTROL LINK
LATCH
SOLENOID LINK
88470G29

Fig. 34 A common door link attachment to the latch

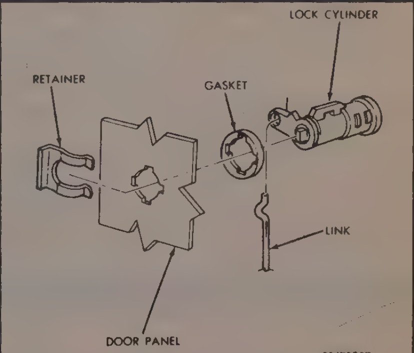

LOCK CYLINDER
RETAINER
GASKET
LINK
DOOR PANEL
88470G27

Fig. 35 Exploded view of a common door lock cylinder assembly

Rear Door Latch

➡This procedure applies only to Crew Cab models.

1. Raise the glass to the full UP position.
2. Remove the door trim panel and watershield.
3. Disconnect the rods from the handle and lock cylinder, and from the remote control assembly.
4. Remove the latch assembly attaching screws and remove the latch from the door.
5. Install in the reverse order of removal.

Door Lock Cylinder

See Figures 34 and 35

1. Place the window in the UP position.
2. Remove the trim panel and watershield.
3. Disconnect the actuating rod from the lock control link clip.
4. Slide the retainer away from the lock cylinder.
5. Pull the cylinder from the door.
6. Install in reverse order of removal.

Power Door Lock Actuator

REMOVAL & INSTALLATION

See Figure 36

1. Raise the glass to the full UP position.
2. Remove the door trim panel.
3. Disconnect the motor from the door latch.
4. Remove the motor and swivel bracket from the door by drilling out the pop rivet, or removing the retaining screws.
5. Disconnect the wiring harness.
6. Installation is the reverse of removal.

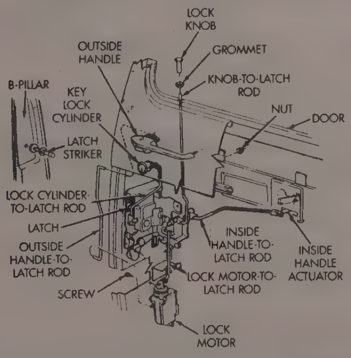

LOCK KNOB
OUTSIDE HANDLE
GROMMET
B-PILLAR
KEY LOCK CYLINDER
KNOB-TO-LATCH ROD
NUT
DOOR
LATCH STRIKER
LOCK CYLINDER-TO-LATCH ROD
LATCH
OUTSIDE HANDLE-TO-LATCH ROD
INSIDE HANDLE-TO-LATCH ROD
INSIDE HANDLE ACTUATOR
LOCK MOTOR-TO-LATCH ROD
SCREW
LOCK MOTOR
88470G31

Fig. 36 Details of a common power door lock and actuator assembly

Tailgate Lock and Linkage

REMOVAL & INSTALLATION

See Figure 37

1. Remove the screws mounting the lock to the inner tailgate sheet metal.
2. Lower the handle and the lock assembly out of the opening in the front of the tailgate sheet metal.
3. Disconnect the clip from the lock-to-linkage.
4. Remove the striker plates on the left and right ends of the tailgate.
5. Remove the linkage through the ends of the gate.
6. Installation is the reverse of removal.

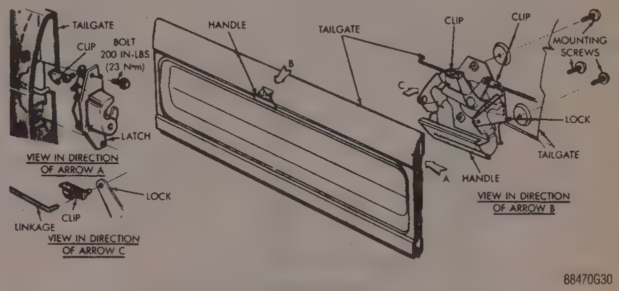

TAILGATE
CLIP
BOLT 200 IN-LBS (23 N·m)
LATCH
VIEW IN DIRECTION OF ARROW A
LOCK
CLIP
LINKAGE
VIEW IN DIRECTION OF ARROW C
HANDLE
B
C
TAILGATE
CLIP
CLIP
MOUNTING SCREWS
LOCK
TAILGATE
A
HANDLE
VIEW IN DIRECTION OF ARROW B
88470G30

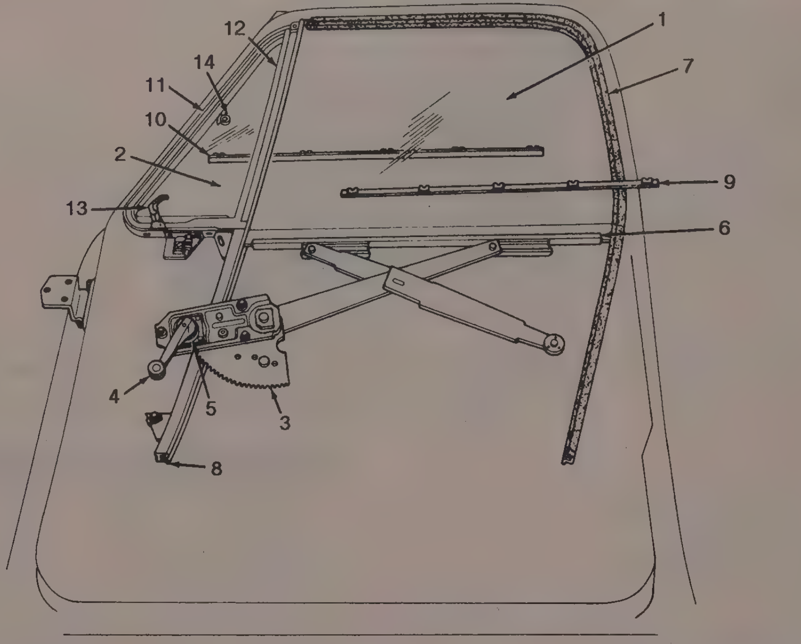
Fig. 37 Exploded view of a common tailgate lock and linkage

Manual Door Glass and Regulator

REMOVAL & INSTALLATION

See Figures 38 and 39

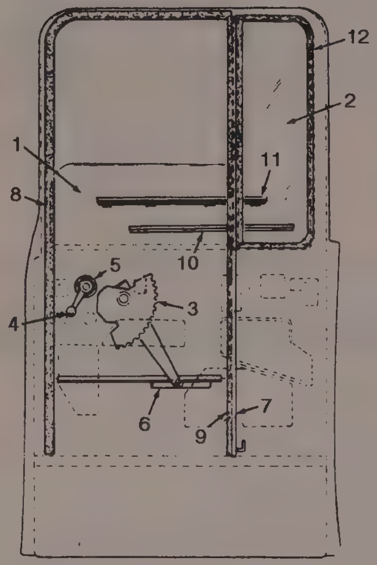
1. Remove the door trim panel.
2. For 1989–93 Pick-ups and all Dakota models, lower the glass fully.
3. For 1994–96 Pick-ups, raise the glass fully, or remove it.
4. On models with stereo, remove the lower trim panel and speaker.
5. On models with a stationary glass panel in the door, remove the panel as follows:
    a. Remove the division channel attaching screws and remove the channel.
    b. Move the glass and weatherstripping forward and out of the opening.
6. Remove the inner weatherstripping.
7. Pull back the upper glass run 8–10 in. (203–254mm) and remove the upper and lower vent window attaching screws.
8. Remove the vent window.
9. Slide the window glass forward off the regulator arms and remove the glass from the door.
10. Drill out the regulator mounting rivets and remove the regulator assembly from the door.



1. Door glass
2. Vent glass
3. Front door regulator
4. Regulator handle
5. Regulator handle spacer
6. Glass lift channel
7. Door glass run
8. Door glass run on division channel
9. Outer belt weatherstrip
10. Inner belt weatherstrip
11. Vent frame
12. Vent weatherstrip
13. Vent handle
14. Vent pivot

88470G32

Fig. 38 Components of a common front door glass system



1. Door glass
2. Vent glass
3. Regulator
4. Regulator handle
5. Handle spacer
6. Glass lift channel
7. Division channel
8. Door glass run
9. Door glass run on division channel
10. Outer belt weatherstrip
11. Inner belt weatherstrip
12. Vent weatherstrip

88470G33

Fig. 39 Components of a common rear door glass system

To install:

11. Position the regulator in the door.
12. Using ¼-20 screws and nuts in place of the rivets, tighten the regulator mounting screws to 90 inch lbs. (10 Nm).
13. Slide the glass onto the regulator arms and into the rear glass run.
14. Install the plastic nut and U-nut on the vent window assembly.
15. Install the vent window assembly into the door.
16. Install the upper and lower vent window attaching screws. Don't tighten them yet.
17. Move the glass run back to the vent window by placing the run adjacent to the door channel and pressing it into the channel using a wide-bladed chisel or similar tool. Press in both corners to insure the hidden lip engages the channel.
18. Install the inner weatherstripping.
19. Raise or lower the vent window to maintain a 0.06 in. (1.6mm) fore-aft glass free-play. Then, with the glass up, tighten the upper screws.
20. Hold the vent against the glass, with the glass down, and tighten the lower screws.
21. On models with a stationary glass panel:
    a. Position the glass and weatherstripping in the window opening and insert it into the upper frame.
    b. Insert the division channel run into the channel.
    c. With the door glass in the down position, insert the division channel in the door and move it firmly against the stationary glass weatherstripping.
    d. Install, but don't tighten, the upper and lower attaching screws.
    e. Adjust the door glass in the channel.
    f. Tighten the channel against the stationary glass and check for a good seal.
22. Raise the door glass to the full up position.
23. Install the stereo speaker and lower trim.
24. Install the watershield and door trim panel.

Power Door Glass and Regulator Motor

REMOVAL & INSTALLATION

➧ See Figures 40 and 41

1. Remove the door trim panel.
2. For 1989–93 Pick-ups and all Dakota models, lower the glass fully.
3. For 1994–96 Pick-ups, raise the glass fully, or remove it.
4. On models with stereo, remove the lower trim panel and speaker.
5. Remove the down stop bumper bracket.

6. On models with a stationary glass panel in the door, remove the panel as follows:
   a. Remove the division channel attaching screws and remove the channel.
   b. Move the glass and weatherstripping forward and out of the opening.
7. Remove the inner weatherstripping.
8. Pull back the upper glass run 8–10 in. (203–254mm) and remove the upper and lower vent window attaching screws.
9. Remove the vent window.
10. Lower the glass fully.
11. Slide the window glass forward off the regulator arms and remove the glass from the door.
12. Drill out the regulator mounting rivets and remove the regulator assembly from the door.

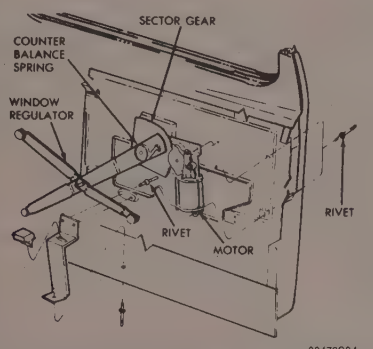


Fig. 40 View of the common power window regulator assembly

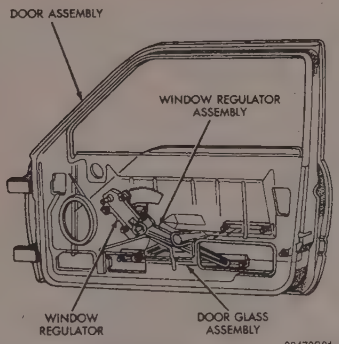


Fig. 41 View of the door glass window regulator assembly—1994–96 Pick-ups

To install:

13. Position the regulator in the door.
14. Using ¼-20 screws and nuts in place of the rivets, tighten the regulator mounting screws to 90 inch lbs. (10 Nm).
15. Slide the glass onto the regulator arms and into the rear glass run.
16. Install the plastic nut and U-nut on the vent window assembly.
17. Install the vent window assembly into the door.
18. Install the upper and lower vent window attaching screws. Don't tighten them yet.
19. Move the glass run back to the vent window by placing the run adjacent to the door channel and pressing it into the channel using a wide-bladed chisel or similar tool. Press in both corners to insure the hidden lip engages the channel.
20. Install the inner weatherstripping.
21. Raise or lower the vent window to maintain a 0.06 in. (1.6mm) fore-aft glass free-play. Then, with the glass up, tighten the upper screws.
22. Hold the vent against the glass, with the glass down, and tighten the lower screws.
23. On models with a stationary glass panel:
   a. Position the glass and weatherstripping in the window opening and insert it into the upper frame.
   b. Insert the division channel run into the channel.
   c. With the door glass in the down position, insert the division channel in the door and move it firmly against the stationary glass weatherstripping.
   d. Install, but don't tighten, the upper and lower attaching screws.
   e. Adjust the door glass in the channel.
   f. Tighten the channel against the stationary glass and check for a good seal.
24. Raise the door glass to the full up position.
25. Install the down stop bumper.
26. Install the stereo speaker and lower trim.
27. Install the watershield and door trim panel.

Electric Window Motor

REMOVAL & INSTALLATION

1. Remove the window regulator. For more details, refer to the window regulator procedure in this section.
2. Remove the electric motor mounting screws, then extract the motor from the door.

To install:

3. Position the window motor into the door, then secure it in place with the mounting screws.
4. Install the window regulator.

Inside Rear View Mirror

REMOVAL & INSTALLATION

◆ **See Figures 42 and 43**

The mirror is held in place with a single setscrew. Loosen the screw and lift the mirror off. If equipped with a power interior mirror, unplug the wire connector while supporting the detached mirror in your hand. The supporting bracket stud is glued to the windshield. Repair kits for damaged mirror support bracket are available at most auto parts stores.

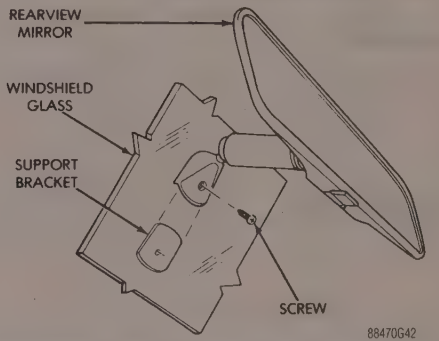


Fig. 42 Unscrew the mirror to remove it from the windshield

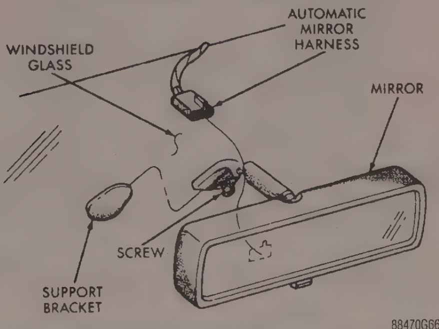


Fig. 43 If so equipped, disconnect the automatic mirror harness once the mirror is detached

TORQUE SPECIFICATIONS

Component	English	Metric
Grade 5 Bolts		
¼–20:	95 inch lbs.	11 Nm
¼–28:	95 inch lbs.	11 Nm
5/16–18:	200 inch lbs.	23 Nm
5/16–24:	20 ft. lbs.	27 Nm
⅜–16:	30 ft. lbs.	41 Nm
⅜–24:	35 ft. lbs.	48 Nm
7/16–14:	50 ft. lbs.	68 Nm
7/16–20:	55 ft. lbs.	75 Nm
½–13:	75 ft. lbs.	102 Nm
½–20:	85 ft. lbs.	115 Nm
9/16–12:	105 ft. lbs.	142 Nm
9/16–18:	115 ft. lbs.	156 Nm
⅝–11:	150 ft. lbs.	203 Nm
⅝–18:	160 ft. lbs.	217 Nm
¾–16:	175 ft. lbs.	237 Nm
Grade 8 Bolts		
¼–20:	125 inch lbs.	14 Nm
¼–28:	150 inch lbs.	17 Nm
5/16–18:	270 inch lbs.	31 Nm
5/16–24:	25 ft. lbs.	34 Nm
⅜–16:	40 ft. lbs.	54 Nm
⅜–24:	45 ft. lbs.	61 Nm
7/16–14:	65 ft. lbs.	88 Nm
7/16–20:	70 ft. lbs.	95 Nm
½–13:	100 ft. lbs.	136 Nm
½–20:	110 ft. lbs.	149 Nm
9/16–12:	135 ft. lbs.	183 Nm
9/16–18:	150 ft. lbs.	203 Nm
⅝–11:	195 ft. lbs.	264 Nm
⅝–18:	210 ft. lbs.	285 Nm
¾–16:	225 ft. lbs.	305 Nm
Bolts marked 6T		
6mm:	5–7 ft. lbs.	7–10 Nm
8mm:	12–17 ft. lbs.	16–23 Nm
10mm:	23–34 ft. lbs.	31–46 Nm
12mm:	41–59 ft. lbs.	56–80 Nm
14mm:	56–76 ft. lbs.	76–103 Nm
Bolts marked 8T		
6mm:	6–9 ft. lbs.	8–12 Nm
8mm:	13–20 ft. lbs.	18–27 Nm
10mm:	27–40 ft. lbs.	37–55 Nm
12mm:	46–69 ft. lbs.	63–94 Nm
14mm:	75–101 ft. lbs.	102–137 Nm

88470C02

GLOSSARY

AIR/FUEL RATIO: The ratio of air-to-gasoline by weight in the fuel mixture drawn into the engine.

AIR INJECTION: One method of reducing harmful exhaust emissions by injecting air into each of the exhaust ports of an engine. The fresh air entering the hot exhaust manifold causes any remaining fuel to be burned before it can exit the tailpipe.

ALTERNATOR: A device used for converting mechanical energy into electrical energy.

AMMETER: An instrument, calibrated in amperes, used to measure the flow of an electrical current in a circuit. Ammeters are always connected in series with the circuit being tested.

AMPERE: The rate of flow of electrical current present when one volt of electrical pressure is applied against one ohm of electrical resistance.

ANALOG COMPUTER: Any microprocessor that uses similar (analogous) electrical signals to make its calculations.

ARMATURE: A laminated, soft iron core wrapped by a wire that converts electrical energy to mechanical energy as in a motor or relay. When rotated in a magnetic field, it changes mechanical energy into electrical energy as in a generator.

ATMOSPHERIC PRESSURE: The pressure on the Earth's surface caused by the weight of the air in the atmosphere. At sea level, this pressure is 14.7 psi at 32°F (101 kPa at 0°C).

ATOMIZATION: The breaking down of a liquid into a fine mist that can be suspended in air.

AXIAL PLAY: Movement parallel to a shaft or bearing bore.

BACKFIRE: The sudden combustion of gases in the intake or exhaust system that results in a loud explosion.

BACKLASH: The clearance or play between two parts, such as meshed gears.

BACKPRESSURE: Restrictions in the exhaust system that slow the exit of exhaust gases from the combustion chamber.

BAKELITE: A heat resistant, plastic insulator material commonly used in printed circuit boards and transistorized components.

BALL BEARING: A bearing made up of hardened inner and outer races between which hardened steel balls roll.

BALLAST RESISTOR: A resistor in the primary ignition circuit that lowers voltage after the engine is started to reduce wear on ignition components.

BEARING: A friction reducing, supportive device usually located between a stationary part and a moving part.

BIMETAL TEMPERATURE SENSOR: Any sensor or switch made of two dissimilar types of metal that bend when heated or cooled due to the different expansion rates of the alloys. These types of sensors usually function as an on/off switch.

BLOWBY: Combustion gases, composed of water vapor and unburned fuel, that leak past the piston rings into the crankcase during normal engine operation. These gases are removed by the PCV system to prevent the buildup of harmful acids in the crankcase.

BRAKE PAD: A brake shoe and lining assembly used with disc brakes.

BRAKE SHOE: The backing for the brake lining. The term is, however, usually applied to the assembly of the brake backing and lining.

BUSHING: A liner, usually removable, for a bearing; an anti-friction liner used in place of a bearing.

CALIPER: A hydraulically activated device in a disc brake system, which is mounted straddling the brake rotor (disc). The caliper contains at least one piston and two brake pads. Hydraulic pressure on the piston(s) forces the pads against the rotor.

CAMSHAFT: A shaft in the engine on which are the lobes (cams) which operate the valves. The camshaft is driven by the crankshaft, via a belt, chain or gears, at one half the crankshaft speed.

CAPACITOR: A device which stores an electrical charge.

CARBON MONOXIDE (CO): A colorless, odorless gas given off as a normal byproduct of combustion. It is poisonous and extremely dangerous in confined areas, building up slowly to toxic levels without warning if adequate ventilation is not available.

CARBURETOR: A device, usually mounted on the intake manifold of an engine, which mixes the air and fuel in the proper proportion to allow even combustion.

CATALYTIC CONVERTER: A device installed in the exhaust system, like a muffler, that converts harmful byproducts of combustion into carbon dioxide and water vapor by means of a heat-producing chemical reaction.

CENTRIFUGAL ADVANCE: A mechanical method of advancing the spark timing by using flyweights in the distributor that react to centrifugal force generated by the distributor shaft rotation.

CHECK VALVE: Any one-way valve installed to permit the flow of air, fuel or vacuum in one direction only.

CHOKE: A device, usually a moveable valve, placed in the intake path of a carburetor to restrict the flow of air.

CIRCUIT: Any unbroken path through which an electrical current can flow. Also used to describe fuel flow in some instances.

CIRCUIT BREAKER: A switch which protects an electrical circuit from overload by opening the circuit when the current flow exceeds a predetermined level. Some circuit breakers must be reset manually, while most reset automatically.

COIL (IGNITION): A transformer in the ignition circuit which steps up the voltage provided to the spark plugs.

COMBINATION MANIFOLD: An assembly which includes both the intake and exhaust manifolds in one casting.

COMBINATION VALVE: A device used in some fuel systems that routes fuel vapors to a charcoal storage canister instead of venting them into the atmosphere. The valve relieves fuel tank pressure and allows fresh air into the tank as the fuel level drops to prevent a vapor lock situation.

COMPRESSION RATIO: The comparison of the total volume of the cylinder and combustion chamber with the piston at BDC and the piston at TDC.

CONDENSER: 1. An electrical device which acts to store an electrical charge, preventing voltage surges. 2. A radiator-like device in the air conditioning system in which refrigerant gas condenses into a liquid, giving off heat.

CONDUCTOR: Any material through which an electrical current can be transmitted easily.

CONTINUITY: Continuous or complete circuit. Can be checked with an ohmmeter.

COUNTERSHAFT: An intermediate shaft which is rotated by a mainshaft and transmits, in turn, that rotation to a working part.

CRANKCASE: The lower part of an engine in which the crankshaft and related parts operate.

CRANKSHAFT: The main driving shaft of an engine which receives reciprocating motion from the pistons and converts it to rotary motion.

CYLINDER: In an engine, the round hole in the engine block in which the piston(s) ride.

CYLINDER BLOCK: The main structural member of an engine in which is found the cylinders, crankshaft and other principal parts.

CYLINDER HEAD: The detachable portion of the engine, usually fastened to the top of the cylinder block and containing all or most of the combustion chambers. On overhead valve engines, it contains the valves and their operating parts. On overhead cam engines, it contains the camshaft as well.

DEAD CENTER: The extreme top or bottom of the piston stroke.

DETONATION: An unwanted explosion of the air/fuel mixture in the combustion chamber caused by excess heat and compression, advanced timing, or an overly lean mixture. Also referred to as "ping".

DIAPHRAGM: A thin, flexible wall separating two cavities, such as in a vacuum advance unit.

DIESELING: A condition in which hot spots in the combustion chamber cause the engine to run on after the key is turned off.

DIFFERENTIAL: A geared assembly which allows the transmission of motion between drive axles, giving one axle the ability to turn faster than the other.

DIODE: An electrical device that will allow current to flow in one direction only.

DISC BRAKE: A hydraulic braking assembly consisting of a brake disc, or rotor, mounted on an axle, and a caliper assembly containing, usually two brake pads which are activated by hydraulic pressure. The pads are forced against the sides of the disc, creating friction which slows the vehicle.

DISTRIBUTOR: A mechanically driven device on an engine which is responsible for electrically firing the spark plug at a predetermined point of the piston stroke.

DOWEL PIN: A pin, inserted in mating holes in two different parts allowing those parts to maintain a fixed relationship.

DRUM BRAKE: A braking system which consists of two brake shoes and one or two wheel cylinders, mounted on a fixed backing plate, and a brake drum, mounted on an axle, which revolves around the assembly.

DWELL: The rate, measured in degrees of shaft rotation, at which an electrical circuit cycles on and off.

ELECTRONIC CONTROL UNIT (ECU): Ignition module, module, amplifier or igniter. See Module for definition.

ELECTRONIC IGNITION: A system in which the timing and firing of the spark plugs is controlled by an electronic control unit, usually called a module. These systems have no points or condenser.

END-PLAY: The measured amount of axial movement in a shaft.

ENGINE: A device that converts heat into mechanical energy.

EXHAUST MANIFOLD: A set of cast passages or pipes which conduct exhaust gases from the engine.

FEELER GAUGE: A blade, usually metal, or precisely predetermined thickness, used to measure the clearance between two parts.

FIRING ORDER: The order in which combustion occurs in the cylinders of an engine. Also the order in which spark is distributed to the plugs by the distributor.

FLOODING: The presence of too much fuel in the intake manifold and combustion chamber which prevents the air/fuel mixture from firing, thereby causing a no-start situation.

FLYWHEEL: A disc shaped part bolted to the rear end of the crankshaft. Around the outer perimeter is affixed the ring gear. The starter drive engages the ring gear, turning the flywheel, which rotates the crankshaft, imparting the initial starting motion to the engine.

FOOT POUND (ft. lbs. or sometimes, ft.lb.): The amount of energy or work needed to raise an item weighing one pound, a distance of one foot.

FUSE: A protective device in a circuit which prevents circuit overload by breaking the circuit when a specific amperage is present. The device is constructed around a strip or wire of a lower amperage rating than the circuit it is designed to protect. When an amperage higher than that stamped on the fuse is present in the circuit, the strip or wire melts, opening the circuit.

GEAR RATIO: The ratio between the number of teeth on meshing gears.

GENERATOR: A device which converts mechanical energy into electrical energy.

HEAT RANGE: The measure of a spark plug's ability to dissipate heat from its firing end. The higher the heat range, the hotter the plug fires.

HUB: The center part of a wheel or gear.

HYDROCARBON (HC): Any chemical compound made up of hydrogen and carbon. A major pollutant formed by the engine as a byproduct of combustion.

HYDROMETER: An instrument used to measure the specific gravity of a solution.

INCH POUND (inch lbs.; sometimes in.lb. or in. lbs.): One twelfth of a foot pound.

INDUCTION: A means of transferring electrical energy in the form of a magnetic field. Principle used in the ignition coil to increase voltage.

INJECTOR: A device which receives metered fuel under relatively low pressure and is activated to inject the fuel into the engine under relatively high pressure at a predetermined time.

INPUT SHAFT: The shaft to which torque is applied, usually carrying the driving gear or gears.

INTAKE MANIFOLD: A casting of passages or pipes used to conduct air or a fuel/air mixture to the cylinders.

JOURNAL: The bearing surface within which a shaft operates.

KEY: A small block usually fitted in a notch between a shaft and a hub to prevent slippage of the two parts.

MANIFOLD: A casting of passages or set of pipes which connect the cylinders to an inlet or outlet source.

MANIFOLD VACUUM: Low pressure in an engine intake manifold formed just below the throttle plates. Manifold vacuum is highest at idle and drops under acceleration.

MASTER CYLINDER: The primary fluid pressurizing device in a hydraulic system. In automotive use, it is found in brake and hydraulic clutch systems and is pedal activated, either directly or, in a power brake system, through the power booster.

MODULE: Electronic control unit, amplifier or igniter of solid state or integrated design which controls the current flow in the ignition primary circuit based on input from the pick-up coil. When the module opens the primary circuit, high secondary voltage is induced in the coil.

NEEDLE BEARING: A bearing which consists of a number (usually a large number) of long, thin rollers.

OHM: (Ω) The unit used to measure the resistance of conductor-to-electrical flow. One ohm is the amount of resistance that limits current flow to one ampere in a circuit with one volt of pressure.

OHMMETER: An instrument used for measuring the resistance, in ohms, in an electrical circuit.

OUTPUT SHAFT: The shaft which transmits torque from a device, such as a transmission.

OVERDRIVE: A gear assembly which produces more shaft revolutions than that transmitted to it.

OVERHEAD CAMSHAFT (OHC): An engine configuration in which the camshaft is mounted on top of the cylinder head and operates the valve either directly or by means of rocker arms.

OVERHEAD VALVE (OHV): An engine configuration in which all of the valves are located in the cylinder head and the camshaft is located in the cylinder block. The camshaft operates the valves via lifters and pushrods.

OXIDES OF NITROGEN (NOx): Chemical compounds of nitrogen produced as a byproduct of combustion. They combine with hydrocarbons to produce smog.

OXYGEN SENSOR: Use with the feedback system to sense the presence of oxygen in the exhaust gas and signal the computer which can reference the voltage signal to an air/fuel ratio.

PINION: The smaller of two meshing gears.

PISTON RING: An open-ended ring with fits into a groove on the outer diameter of the piston. Its chief function is to form a seal between the piston and cylinder wall. Most automotive pistons have three rings: two for compression sealing; one for oil sealing.

PRELOAD: A predetermined load placed on a bearing during assembly or by adjustment.

PRIMARY CIRCUIT: the low voltage side of the ignition system which consists of the ignition switch, ballast resistor or resistance wire, bypass, coil, electronic control unit and pick-up coil as well as the connecting wires and harnesses.

PRESS FIT: The mating of two parts under pressure, due to the inner diameter of one being smaller than the outer diameter of the other, or vice versa; an interference fit.

RACE: The surface on the inner or outer ring of a bearing on which the balls, needles or rollers move.

REGULATOR: A device which maintains the amperage and/or voltage levels of a circuit at predetermined values.

RELAY: A switch which automatically opens and/or closes a circuit.

RESISTANCE: The opposition to the flow of current through a circuit or electrical device, and is measured in ohms. Resistance is equal to the voltage divided by the amperage.

RESISTOR: A device, usually made of wire, which offers a preset amount of resistance in an electrical circuit.

RING GEAR: The name given to a ring-shaped gear attached to a differential case, or affixed to a flywheel or as part of a planetary gear set.

ROLLER BEARING: A bearing made up of hardened inner and outer races between which hardened steel rollers move.

ROTOR: 1. The disc-shaped part of a disc brake assembly, upon which the brake pads bear; also called, brake disc. 2. The device mounted atop the distributor shaft, which passes current to the distributor cap tower contacts.

SECONDARY CIRCUIT: The high voltage side of the ignition system, usually above 20,000 volts. The secondary includes the ignition coil, coil wire, distributor cap and rotor, spark plug wires and spark plugs.

SENDING UNIT: A mechanical, electrical, hydraulic or electro-magnetic device which transmits information to a gauge.

SENSOR: Any device designed to measure engine operating conditions or ambient pressures and temperatures. Usually electronic in nature and designed to send a voltage signal to an on-board computer, some sensors may operate as a simple on/off switch or they may provide a variable voltage signal (like a potentiometer) as conditions or measured parameters change.

SHIM: Spacers of precise, predetermined thickness used between parts to establish a proper working relationship.

SLAVE CYLINDER: In automotive use, a device in the hydraulic clutch system which is activated by hydraulic force, disengaging the clutch.

SOLENOID: A coil used to produce a magnetic field, the effect of which is to produce work.

SPARK PLUG: A device screwed into the combustion chamber of a spark ignition engine. The basic construction is a conductive core inside of a ceramic insulator, mounted in an outer conductive base. An electrical charge from the spark plug wire travels along the conductive core and jumps a preset air gap to a grounding point or points at the end of the conductive base. The resultant spark ignites the fuel/air mixture in the combustion chamber.

SPLINES: Ridges machined or cast onto the outer diameter of a shaft or inner diameter of a bore to enable parts to mate without rotation.

TACHOMETER: A device used to measure the rotary speed of an engine, shaft, gear, etc., usually in rotations per minute.

THERMOSTAT: A valve, located in the cooling system of an engine, which is closed when cold and opens gradually in response to engine heating, controlling the temperature of the coolant and rate of coolant flow.

TOP DEAD CENTER (TDC): The point at which the piston reaches the top of its travel on the compression stroke.

TORQUE: The twisting force applied to an object.

TORQUE CONVERTER: A turbine used to transmit power from a driving member to a driven member via hydraulic action, providing changes in drive ratio and torque. In automotive use, it links the driveplate at the rear of the engine to the automatic transmission.

TRANSDUCER: A device used to change a force into an electrical signal.

TRANSISTOR: A semi-conductor component which can be actuated by a small voltage to perform an electrical switching function.

TUNE-UP: A regular maintenance function, usually associated with the replacement and adjustment of parts and components in the electrical and fuel systems of a vehicle for the purpose of attaining optimum performance.

TURBOCHARGER: An exhaust driven pump which compresses intake air and forces it into the combustion chambers at higher than atmospheric pressures. The increased air pressure allows more fuel to be burned and results in increased horsepower being produced.

VACUUM ADVANCE: A device which advances the ignition timing in response to increased engine vacuum.

VACUUM GAUGE: An instrument used to measure the presence of vacuum in a chamber.

VALVE: A device which control the pressure, direction of flow or rate of flow of a liquid or gas.

VALVE CLEARANCE: The measured gap between the end of the valve stem and the rocker arm, cam lobe or follower that activates the valve.

VISCOSITY: The rating of a liquid's internal resistance to flow.

VOLTMETER: An instrument used for measuring electrical force in units called volts. Voltmeters are always connected parallel with the circuit being tested.

WHEEL CYLINDER: Found in the automotive drum brake assembly, it is a device, actuated by hydraulic pressure, which, through internal pistons, pushes the brake shoes outward against the drums.

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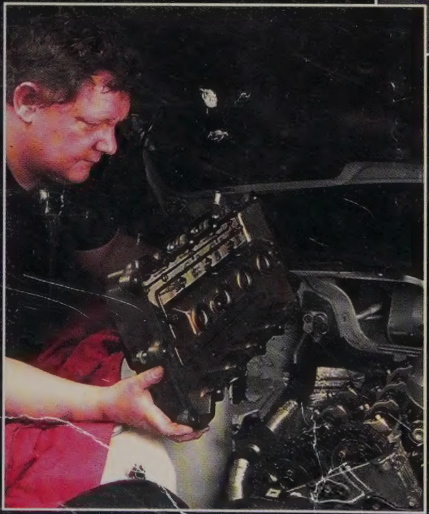

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